AFWAL-TR-88-4064

PROTOTYPE DEVELOPMENT OF AN ELECTROMAGNETIC HARDNESS ASSURANCE MONITORING SYSTEM (HAMS)

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A complete automated electromagnetic hardness assurance monitoring system (HAMS) covering the frequency band of 100 kHz to 500 MHz has been developed. the rationales for the chosen design, the implementation techniques, and operating instructions are presented. The implemented designs are based on highly reliable old technology. The system has worked well in the laboratory but the physical design has not been ruggedized for field use. A hand-held, 12-GHz "sniffer" was developed for use in localizing leaks detected by the HAMS. The sniffer is battery-powered and capable of determining the magnitude of a leak within 2 dB.

Measurements made on an S-250 military shelter and on a baseline and intentionally degraded screen room are presented and discussed. Recommendations for further enhancements to the system are presented.

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PREFACE

This report covers work performed during the period November 1985 to July 1987 under Air Force Contract F33615-85-C-5094. The contract was initiated under Project Number 2418. The work was administered under the direction of the Systems Support Division of the Air Force Wright Aeronautical Laboratories/Materials Laboratory, Wright-Patterson Air Force Base, Ohio. Mr. Robert Urzi (AFWAL/MLSE) acted as Project Engineer.

This work was carried out by Mission Research Corporation (MRC) under subcontract to the University of Dayton Research Institute (UDRI). The program at the UDRI is under the general supervision of Mr. D. Gerdeman, Project Supervisor, with Mr. D. Robert Askins acting as the Principal Investigator and as the point-of-contact with MRC. At MRC, Mr. Paul Trybus acted as the lead engineer with contributions from Messrs. David Schafer and Steven Cave.

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A predecessor report (Ref. 1) presented two conceptual designs for an electromagnetic hardness assurance monitoring system (HAMS). This report discusses the HAMS design which was utilized to build and test a prototype system. This report provides rationales for the chosen design, discusses implementation techniques, and presents operating instructions. We installed the system on a laboratory screen room; the report presents data from HAMS measurements made on the baseline and intentionally degraded screen room. We also discuss HAMS data from measurements made on an S-250 military shelter. The report concludes with recommendations for further enhancements to the system.

II. HAMS DEVELOPMENT

1. PURPOSE

In the design of an electromagnetically hardened shelter, a variety of protective elements such as metal shields, filters, and electrical surge arresters (ESAs) are used which are basically transparent to normal system operation. Daily activities usually provide no indication as to the condition of the electromagnetic (EM) protective elements and their ability to function when needed. CERL investigators (Ref. 2) have indicated that EM shielding performance of shelters can degrade under the most benign conditions.

The HAMS concept provides a means by which the status of the EM protective subsystem can be evaluated and presented to shelter users in near real time. Long-term field use of the HAMS will also provide extensive data on shielding performance as a function of time. Analysis of such data could lead to the development of scheduled, preventative maintenance procedures to restore shielding performance.

2. IMPLEMENTATION

a. General--This hardware development effort of a technically effective system emphasized use of components with low life cycle cost. We avoided expensive, fragile laboratory equipment. When we had a choice, we selected simple, rugged, inexpensive elements to perform the required function. These criteria should also reduce the procurement costs of the system, if it is procured in large quantities.

The major portion of this effort was the design and manufacture of a computer controlled matched receiver and transmitter. The design incorporated the superheterodyne technique of a typical radio receiver. This particular technique provides excellent sensitivity while allowing for a

relatively simple detection scheme. The system is capable of measuring EM shielding integrity using discrete frequencies over the band of 100 kHz to 500 MHz.

The block diagram of Figure 1 presents the overall system. The transmitter of this system uses crystal referenced oscillators in the radio frequency (RF) source. The RF signal is amplified and transmitted to the driver. The receiver detects the signal via the selected sensor. The received signal is mixed with a local oscillator that is 9 MHz greater in frequency than the transmitted signal, and their difference (9 MHz) is sent through a filter to remove unwanted harmonics. The output of the filter is sent through a detector and automatic gain control (AGC) combination.

The heterodyne technique uses no modulation; instead, the magnitude of the carrier/local oscillator difference is measured and scaled. Then, the d.c. scaling factor is digitized and recorded. A second technique was used for the microwave "sniffer" of the system. The sniffer operates at 12 GHz. Since it is very difficult to manufacture microwave devices using discrete components, most of the components of this section were purchased. The technique employed for this higher frequency application does not measure signals relative to the carrier, as did the previous technique. Rather, the amplitude of the modulation imposed on the carrier is measured. The measurement of the modulation enables all of the receiver circuitry--with the exception of the detector--to be sub-microwave components, which are more easily implemented. The GHz system is a hand-held unit, powered by batteries. The 12 GHz transmitter and receiver are depicted in Figure 2.

b. Automated Monitor--The HAMS is comprised of three basic elements. The first is the transmitter/receiver, the second is the computer/microprocessor for control and data recording, and the third is the sensor/driver pairs.

The transmitter is comprised of five RF oscillators, two selector switches, one power amplifier, one variable attenuator (used only in the

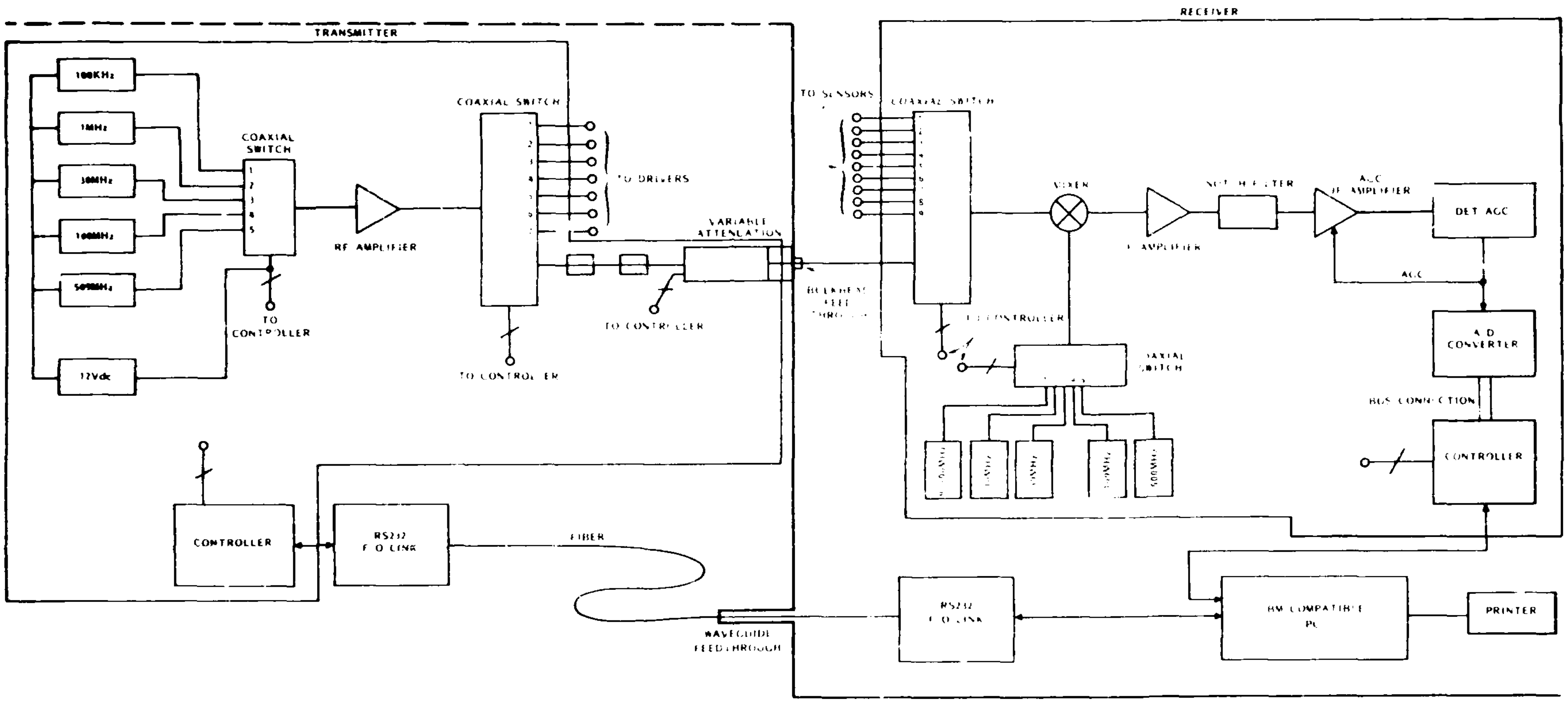

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Figure 1 System block diagram.

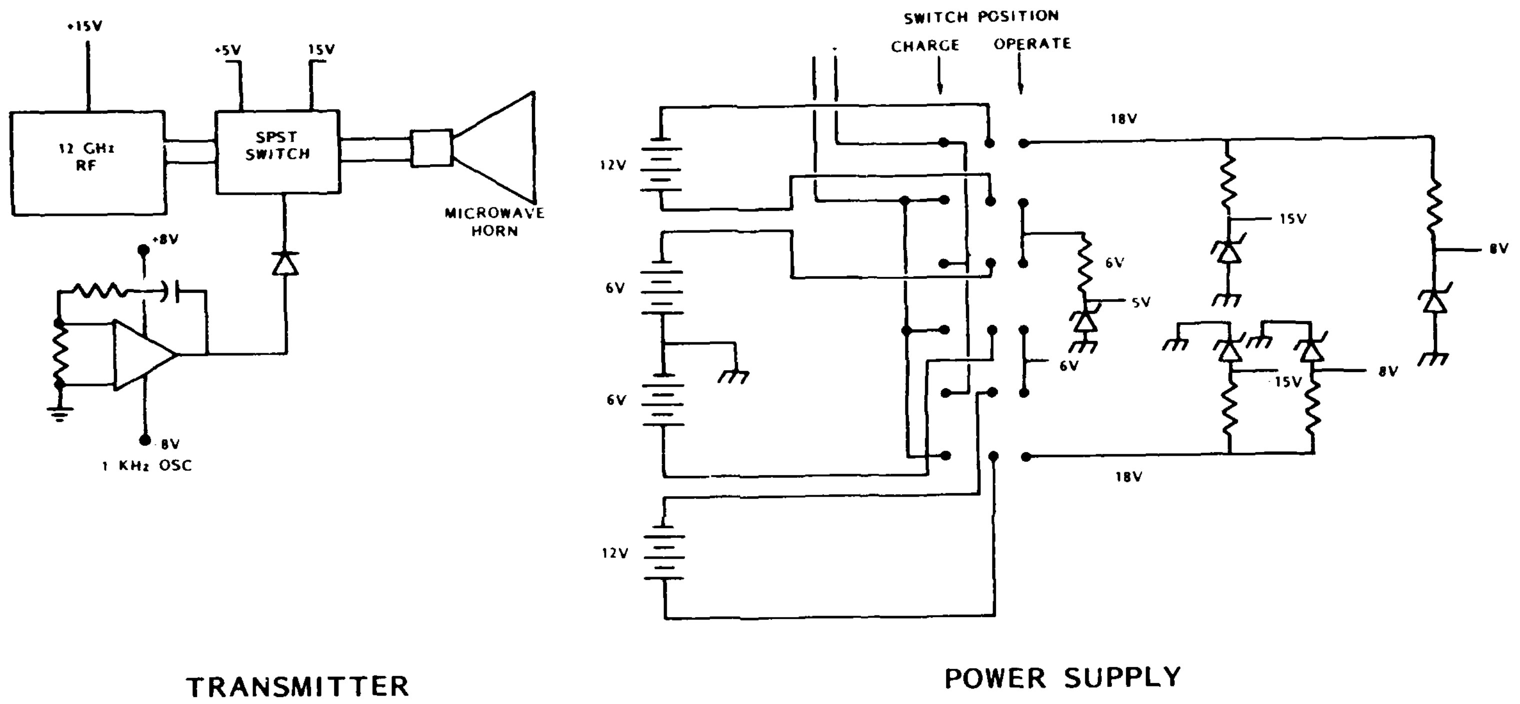

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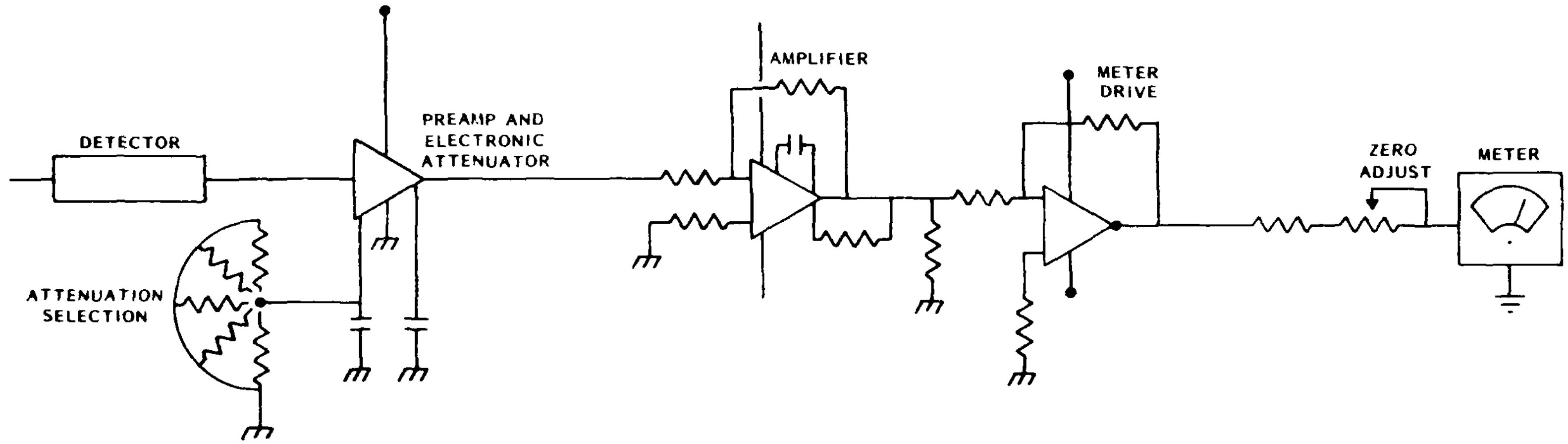
Figure 2. 12 GHz section.



RECEIVER

R-956

Figure 2. 12 GHz section (concluded).

calibration of the system), two power supplies, and one microprocessor. A block diagram of the transmitter was provided in Figure 1. The following figures (3 through 10) provide the schematics or manufacturer's information for each of the elements. The microprocessor will be discussed in the computer interface section to follow. Each of the oscillators were hand-made using commercially and readily available parts. The oscillators use low-frequency crystals as their reference. The reference frequency is then doubled, tripled, or both to obtain the desired output frequency for amplification, application, and transmission through the shielded enclosure. The output of the oscillator is coupled to the input of the RF amplifier through a coaxial switch. The switch is paralleled with relays that provide power connectivity to the selected oscillator. The output of the amplifier is then coupled to a driver placed on the enclosure via another coaxial switch. This final switch determines which driver is to be used. The attenuator is not used in the actual measurement process. It is used only for the calibration of the receiver/transmitter. This will be discussed further in the controller section of this report.

The receiver is comprised of five local oscillators, two selector switches, a mixer, a filter, an AGC, and an analog to digital (A/D) converter. A block diagram of the receiver was provided in Figure 1. The following figures (11 through 17) provide the schematics or manufacturer's information for each of the elements. The oscillators are all powered through their signal lines with the exception of the 500 MHz oscillator. Powering the oscillators through their signal lines minimizes the interface circuitry between the d.c. power and oscillators. This technique was not employed on the 500 MHz oscillator, however, since it was purchased as a complete unit from Vectron (P/N C0233FW, modified for 12-volt operation) and their configuration utilizes a separate power connection.

Figures 18 and 19 provide the physical layout of the transmitter and receiver. The figures are followed by a parts list (Tables 1 and 2), identifying the element and manufacturer.

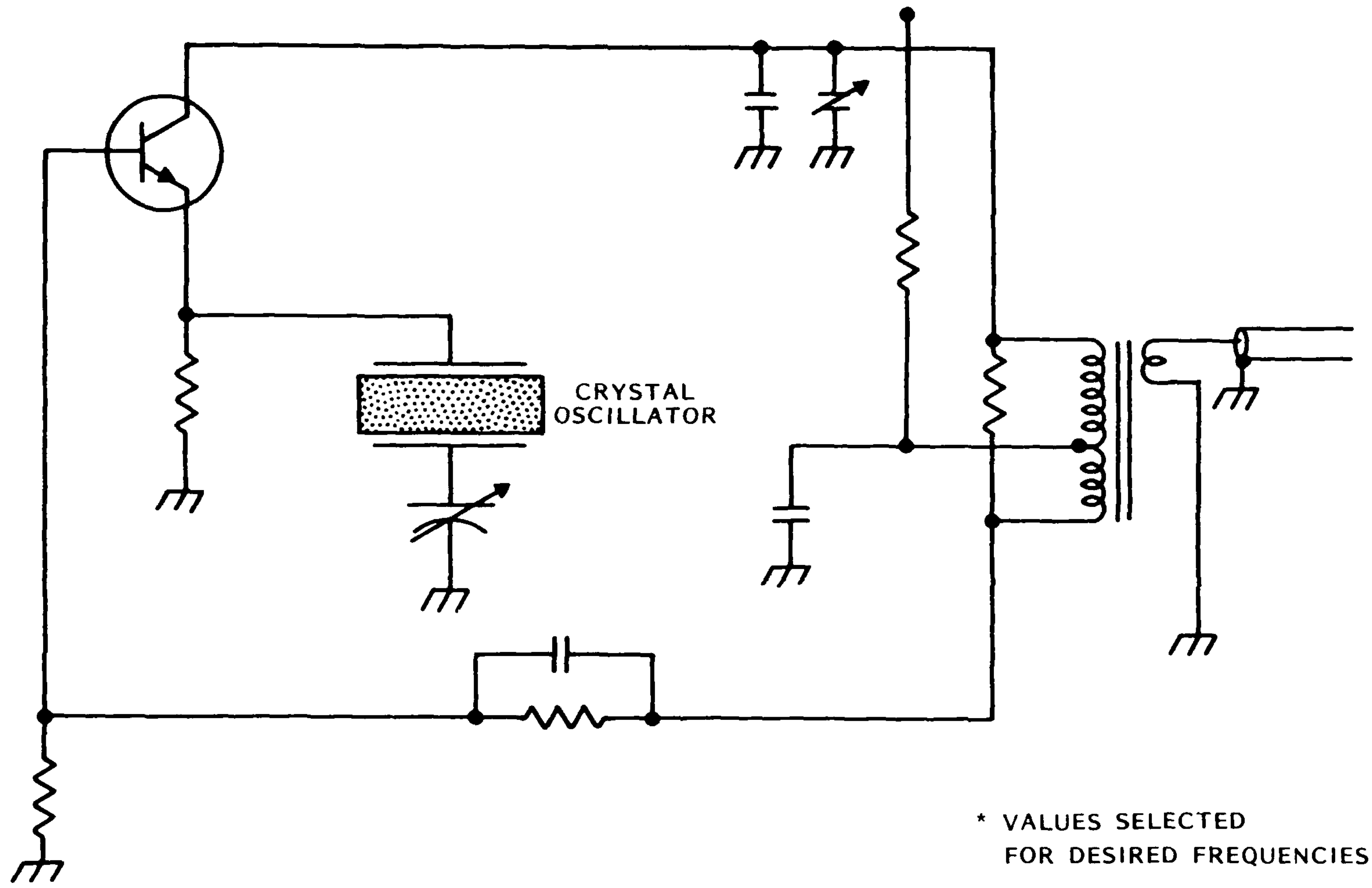


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Figure 3. Low-frequency oscillators, 100 kHz to 30 MHz.

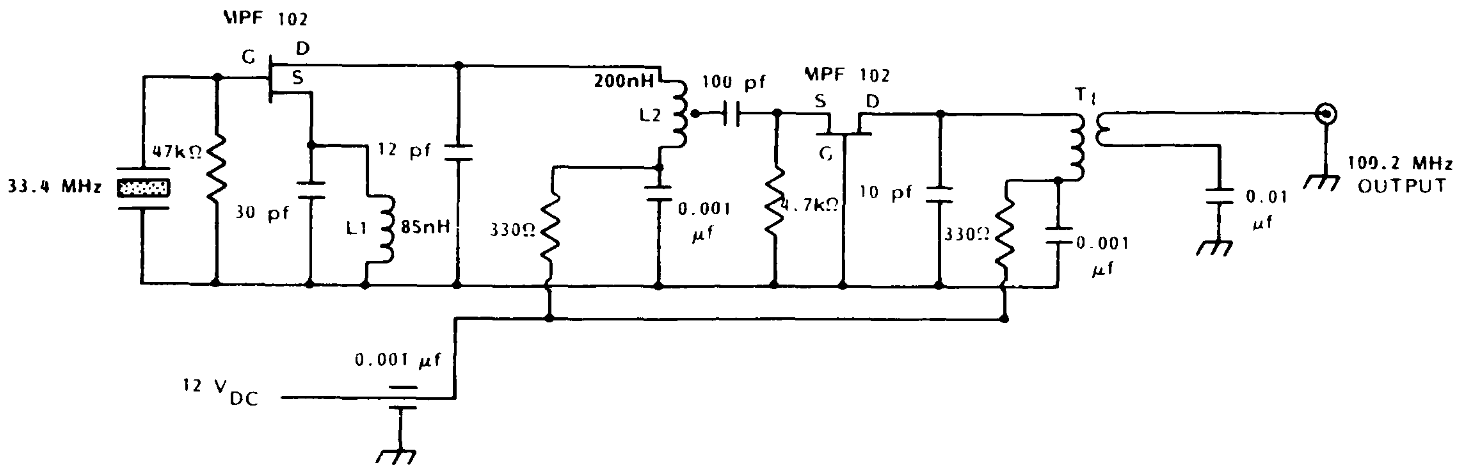

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Figure 4. 100 MHz oscillator.

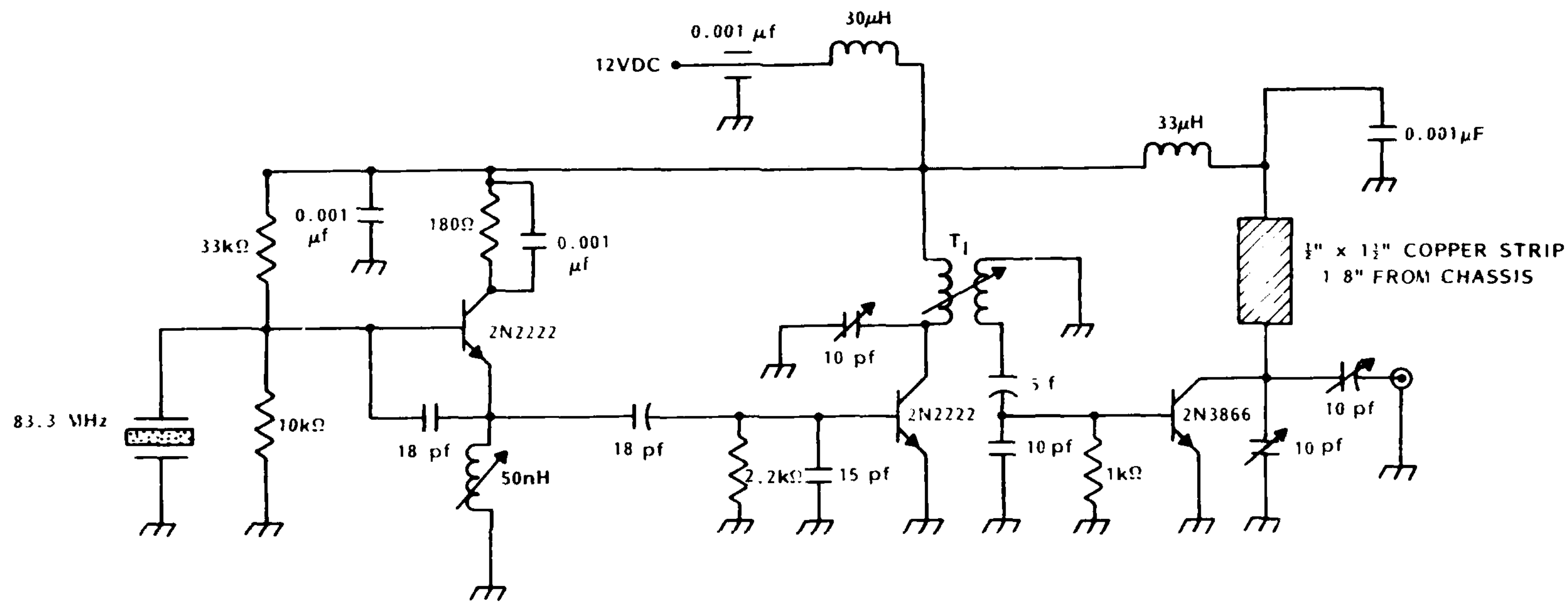

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Figure 5. 500 MHz oscillator.

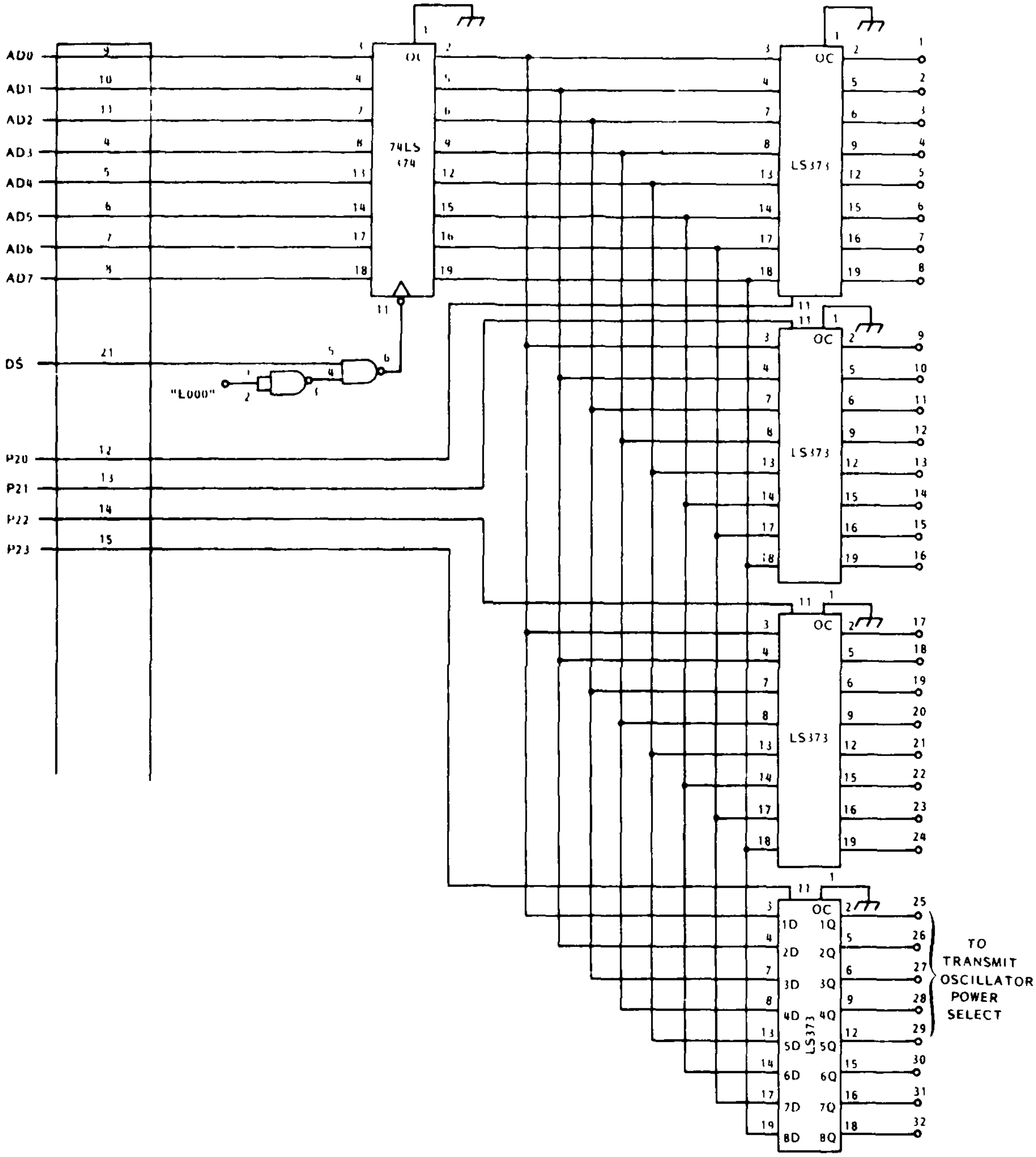


Figure 6. Logic interface for switch and oscillator control (transmitter).

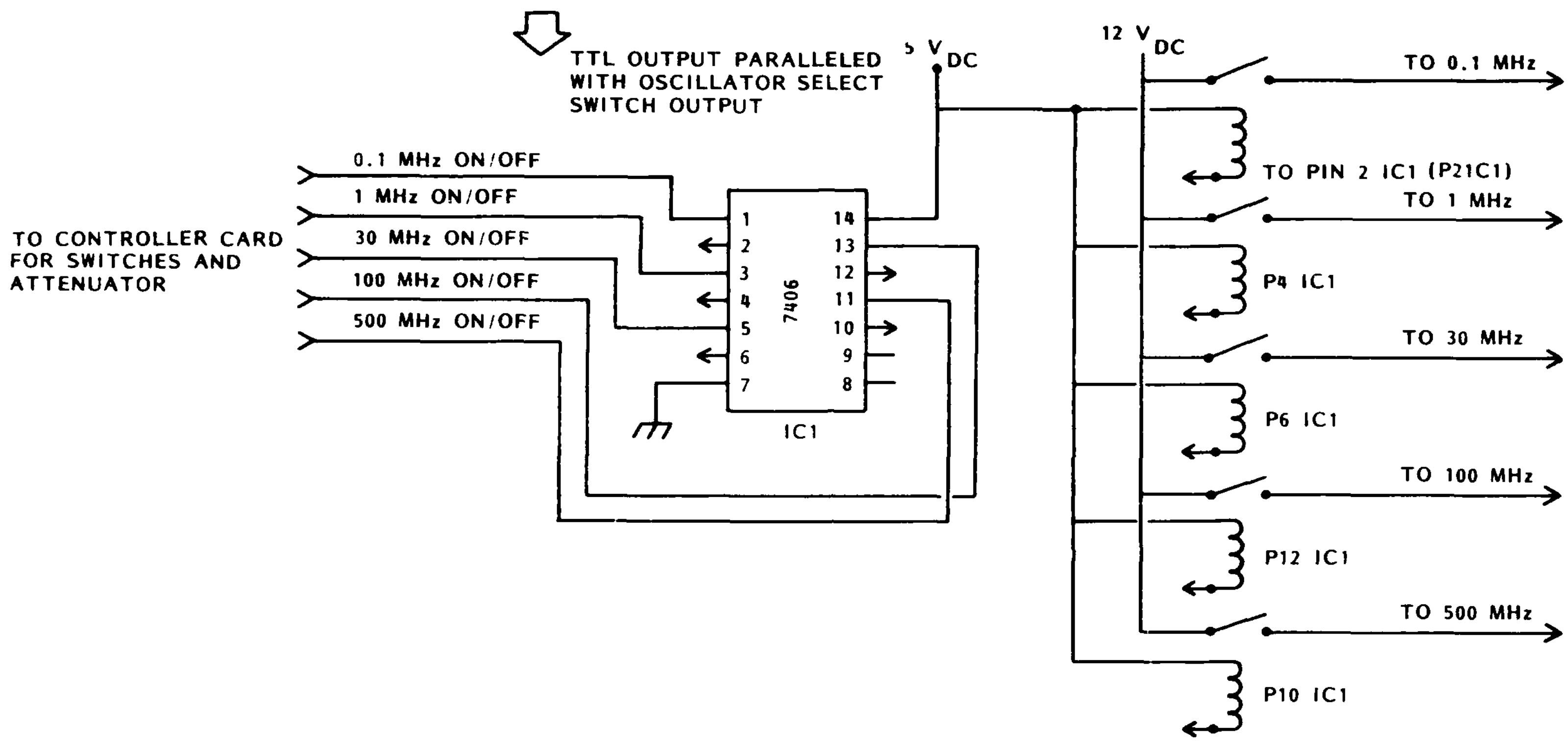


Figure 7. Supplemental logic and oscillator power (transmitter).

Micromint Z8 System Controllers

Introduction

The Micromint Z8 System offers all the parts and development tools necessary for custom development of both process control and data acquisition systems - from hardware and software prototyping to pre-production field trials to full production. A Micromint Z8 System can range from the single board System/Controller to a customized bus-oriented rack mount system consisting of the entire family of Micromint boards: Serial Expansion Interface, AC/DC Power I/O Interface, 16K Memory Expansion boards, 8 Channel 8 Bit Analog-to-Digital Converter, EPROM Programmer, Memory & Parallel I/O Expansion & Cassette Storage Interface, Term-Mite Smart Terminal Board, and either a Z8 BASIC System/Controller or a Z8 FORTH System/Controller.

The heart of the system is built around the Zilog Z8 single chip microcomputer which offers fast execution, efficient memory use, and sophisticated interrupt, input/output, and bit-manipulation capabilities. For ease and speed of software development, the BASIC System/Controller features a BASIC interpreter which also allows easy linkage to assembly language subroutines for more time-critical applications. The FORTH System/Controller substitutes the FORTH language compiler on a Micromint custom masked chip in place of the BASIC interpreter. FORTH was originally developed for process control and rivals assembly language in speed of execution.

Both System/Controllers contain up to 6K bytes of RAM or EPROM (6K for the BASIC model, up to 4K for the FORTH model), an RS-232 serial port (110 to 9600 baud, 7 bits, no parity), parallel ports (1 8-bit bit programmable, 1 8-bit partially programmable - 2 bits dedicated to serial I/O; and 1 8-bit memory-mapped input only port- 4 bits dedicated to reading the baud rate switch), and a dual 22 pin expansion bus edge connector. Simply add a +5 volt power supply (and +/- 12 volts if the RS-232 port is required) and a terminal, and your system is ready to be used for application development - functions which were previously accomplished with TTL logic or with a microprocessor and peripherals. Typical applications include intelligent instrumentation, solar heating control systems, telephone switching systems, industrial controllers, video display control, process control, printer controllers, and security alarm systems.

BASIC System/Controller BASIC

BASIC System/Controller BASIC

This is a ROM-resident version of Tiny BASIC which uses integer arithmetic. It features its own editor and can call machine language subroutines for increased execution speed. It allows complete memory and register interrogation and modification.

FORTH System/Controller FORTH

FORTH System Controller FORTH

Micromint FORTH is provided on a custom masked Z8 and includes a full screen editor, cassette I/O driver primitives, EPROM programmer primitives, and some words which facilitate the writing of a HEX file loader for machine code down loading.

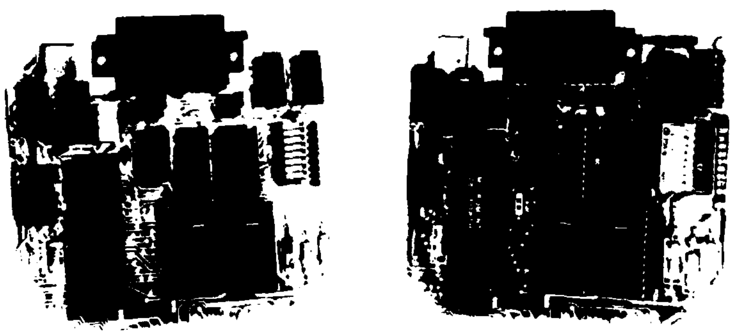


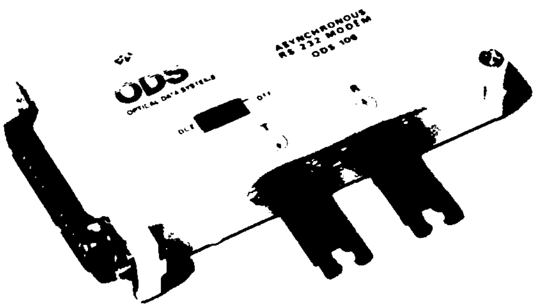
Figure 8. Transmitter and receiver microprocessor.

OPTICAL DATA SYSTEMS

ODS 106

SIGNAL POWERED RS 232 ASYNCHRONOUS FIBER OPTIC MODEM

- Full Duplex Asynchronous DC - 56 Kb/s
- Replaces Conventional Metallic Cabling to 250 Feet (76 m) Using Low Cost 1 mm Plastic Fibers
- Powered by the RS 232 signals alone Requires no power cube
- Fully RS 232 compliant output signal levels
- Low Cost - competitive with metallic line drivers
- Highly Reliable
- DTE/DCE Switch for interface compatibility



The ODS 106 fiber optic RS 232 modem is a plug compatible replacement for most 3 thru 9 wire RS 232 cables and wire modems The use of very low cost acrylic cables makes this link a cost effective solution for distances from a few feet to 250 feet These optical modems support asynchronous data rates to 56 Kb/s and cost less than wire modems which only operate to 300 1200 or 9600 b/s

Connection to the host computer terminal or printer is made by the integral 25 pin RS 232 connector The use of side mounted optical connectors and short overall length of the modem requires only a four inch clearance between the host s interface connector and nearby walls or cabinet doors

An externally selectable switch enables use of the unit with either DTE or DCE host equipment In addition to switching data pins 2 and 3, the switch also interchanges all of the primary control lines to assure widespread interface compatibility

There is no need for power cords or batteries. because the unit is powered entirely by the RS 232 interface signals The optical modems are completely transparent to the transmitted data and exhibit extremely long life because of their low power design

The ODS 106 operates with visible red light to make use of very low cost 1mm acrylic core fibers like those used in cars Termination of the plastic optical fiber is easily done with ordinary wire strippers and pliers Installation of each AMP DNP connector takes about one minute and costs less than 50 cents The ODS 106 is supplied with either a male or female 25 pin interface connector for compatibility with host equipment

Besides the economic advantages of using the ODS 106 in place of metallic interconnects. this link easily meets FCC emission standards. eliminates EMI problems. saves installation time. conserves duct space. and allows full 56 Kb/s data rates independent of distance In addition. the unit prevents signal radiation which can cause interference with other equipment and provides an easy method of penetrating screen rooms

CONSTRAINTS IMPOSED ON USER EQUIPMENT FOR PROPER MODEM OPERATION

1 At least one modem control line on the host must be statically high at all times That one line can be on any one of the following pins 4, 5 6, 8, 9, 19 or 20 (The optical receiver is powered by this signal)

2 The user equipment must not require that any control lines (DTR-DSR etc) be used for link flow control ie all printers must be configured for X-On, X-Off or other serial flow control

IF THESE CONDITIONS ARE NOT MET

1 If no control line is high use the ODS 109

2 If you need hardware handshaking, use the ODS 101 and glass fiber cable

Figure 9. Fiber optic link.

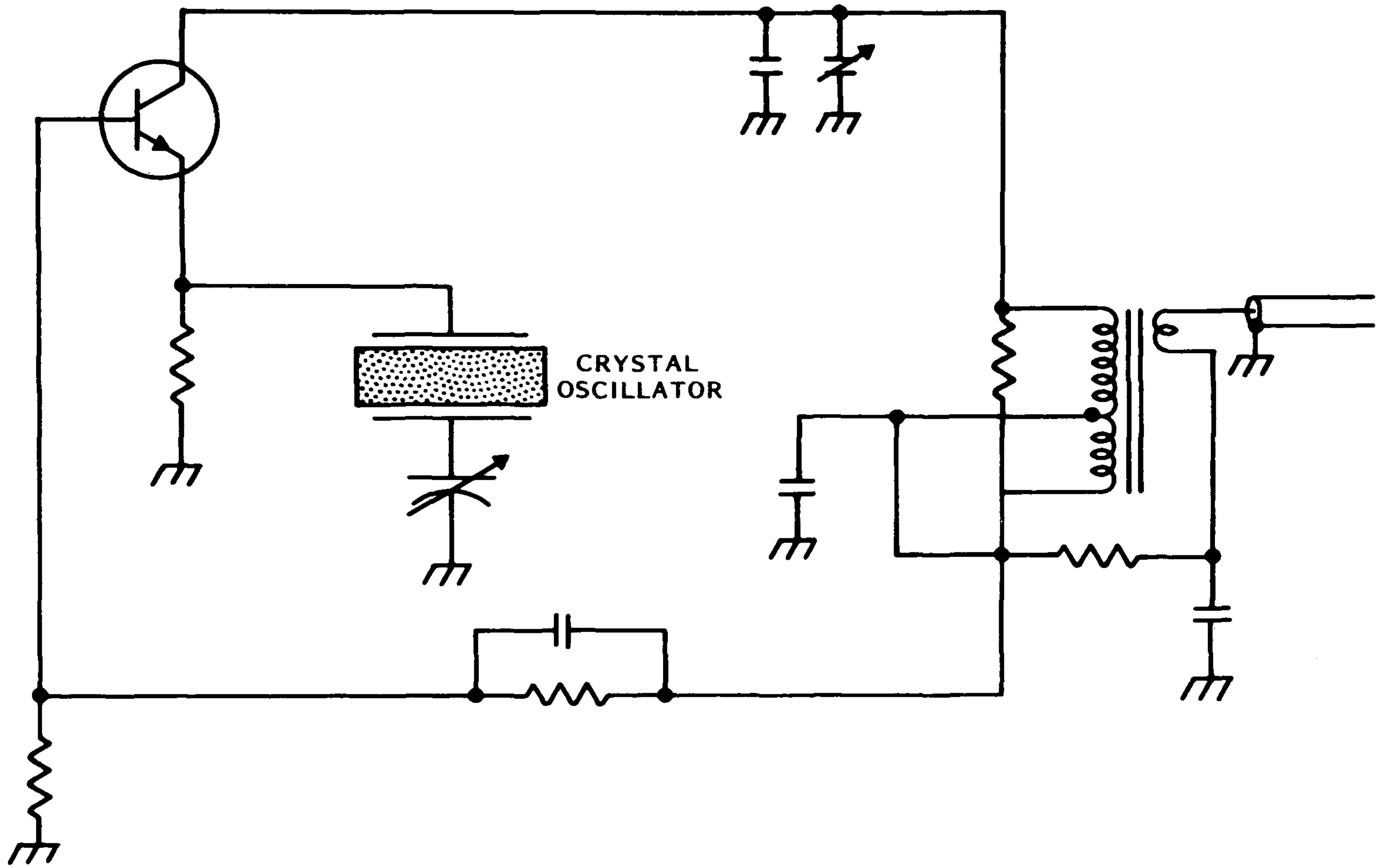


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Figure 10. Low-frequency oscillator, 9100 kHz to 39 MHz (receiver).

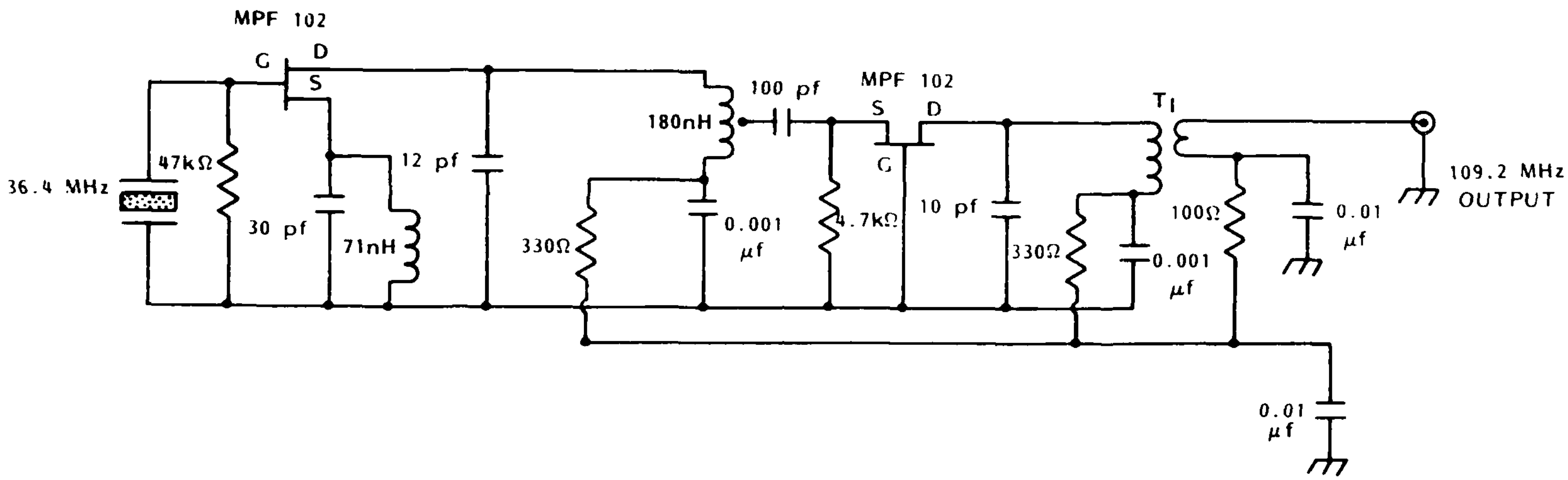

Figure 11. 109 MHz oscillator (receiver).

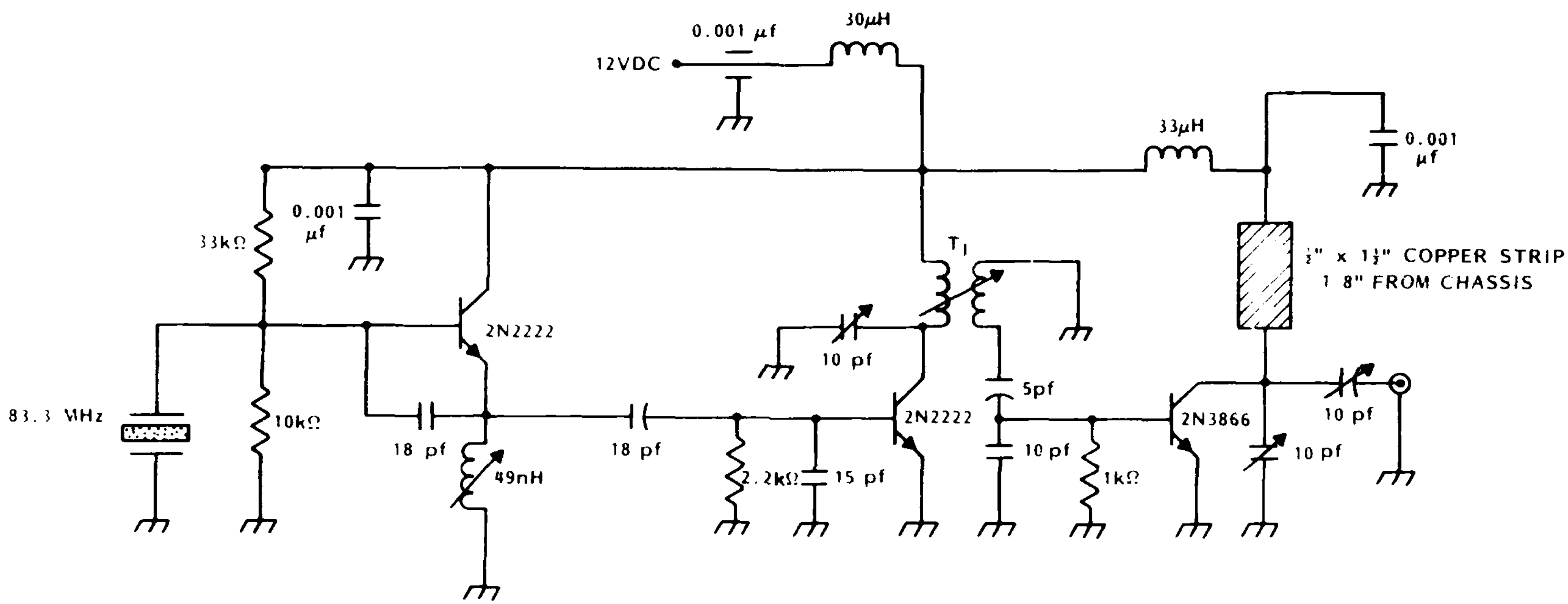

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Figure 12. 509 MHz oscillator (receiver).

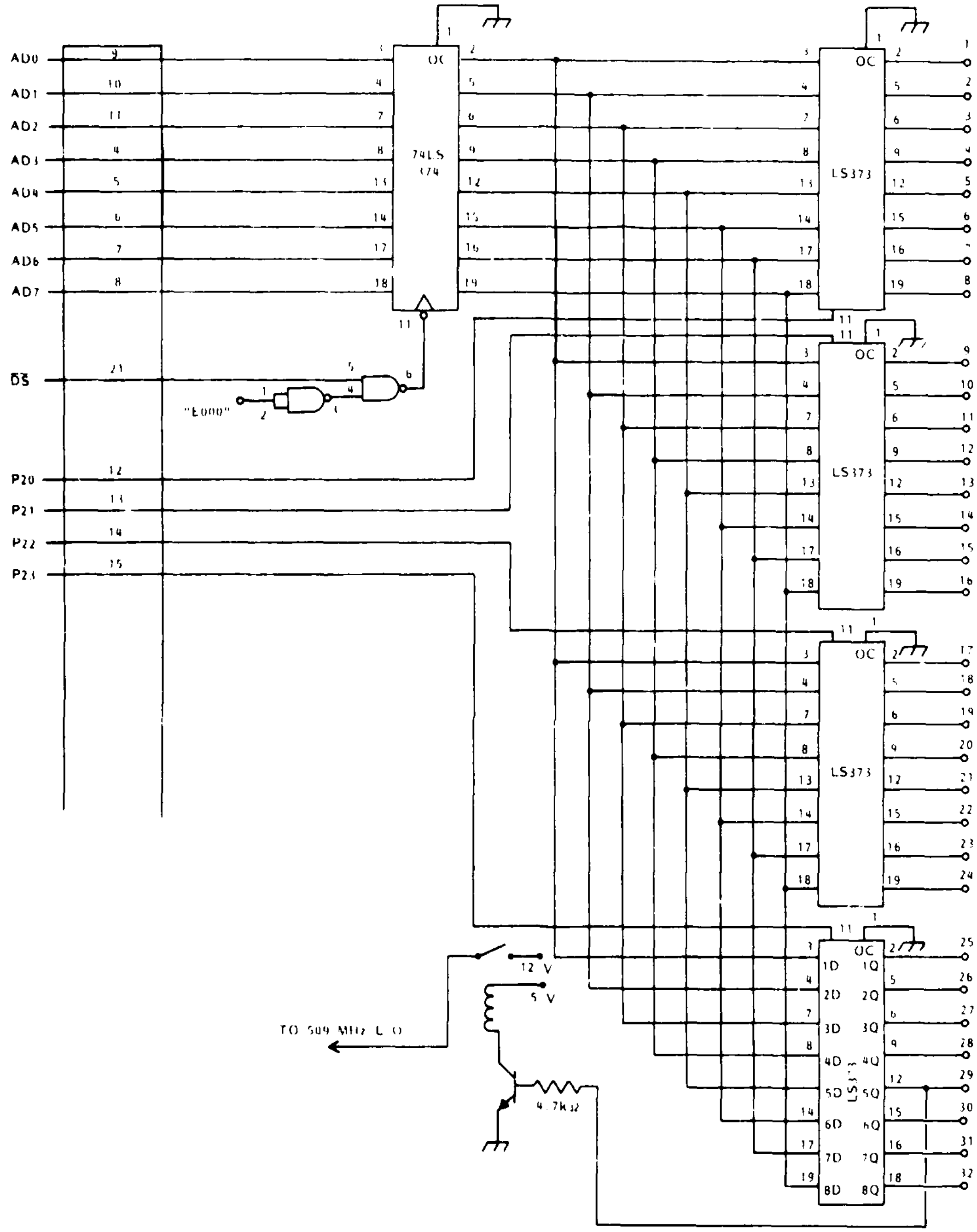

Figure 13. Logic interface for switch and oscillator control (receiver).

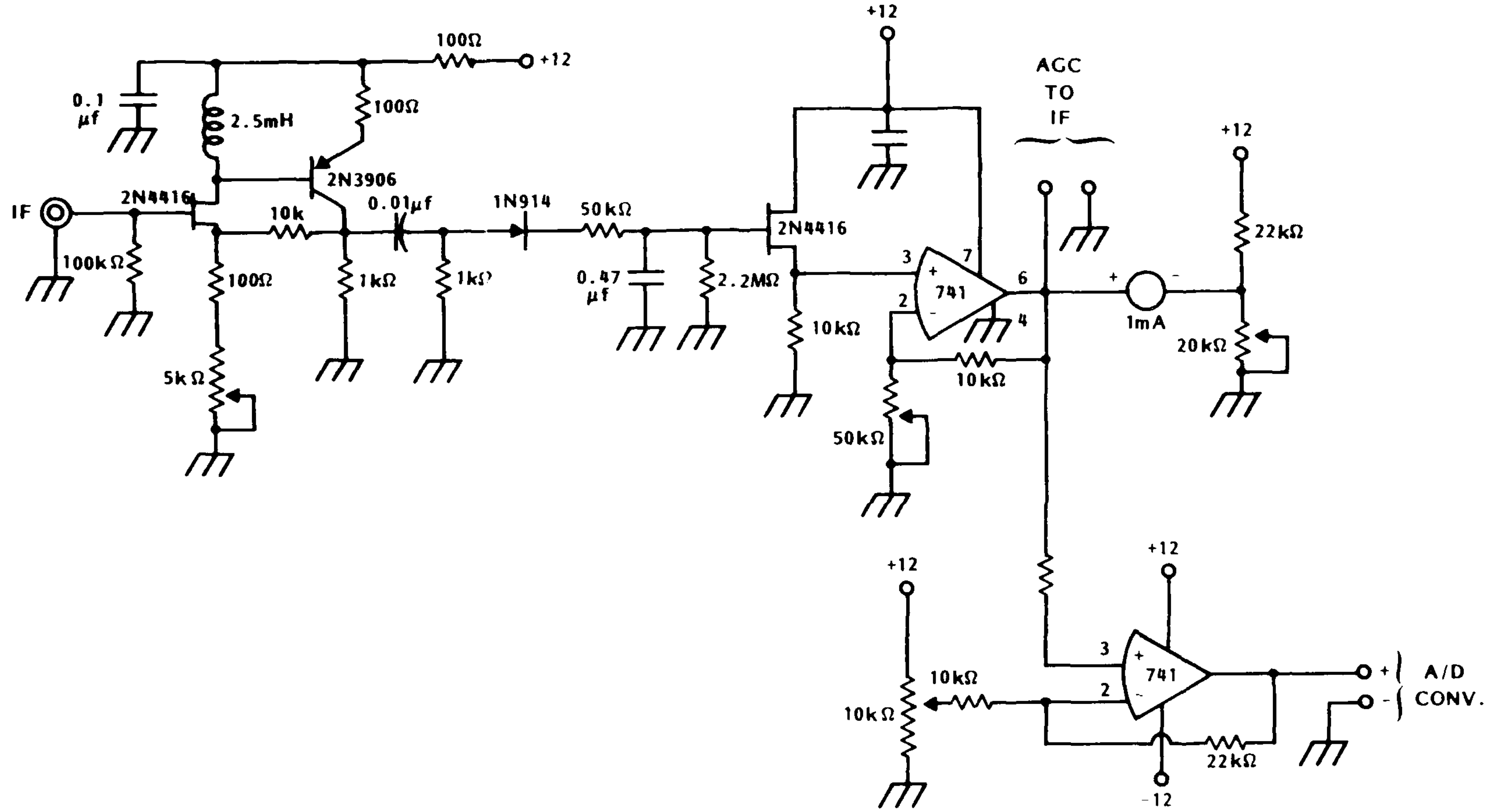

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Figure 14. AGC section (receiver).

4

Miniature Crystal Filters

Model No.	XF-910	XM-107-S04
Centre Frequency	9.0 MHz	10.7 MHz
No. of Poles	2	4
Bandwidth (min)	15 KHz	14 KHz
Ripple, peak (max)	1 dB	1 dB
Insertion Loss (max)	0.5 dB	3 dB
Stopband:		
Bandwidth, -25 dB	60 KHz max	
-30 dB	90 KHz max	
-40 dB		42 KHz max
Ultimate Rejection	40 dB min	60 dB min
Terminations:		
Input, ohms / pF	6000 / zero	910 / 35
Output,ohms / pF	6000 / zero	910 / 35
Mechanical:	Hc18/u	Hc6/u

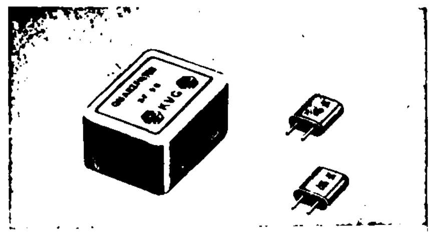
CRYSTAL DISCRIMINATORS – STANDARD SERIES

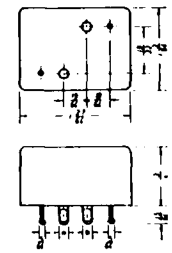
	9 MHz		10,7 MHz	
Type	XD-9-01	XD-9-02	XD-107-01	XD-107-02
Frequency of zero-crossing f_o	9,0 MHz ± 200 Hz		10,7 MHz ± 300 Hz	
Peak deviation	± 5 kHz	± 10 kHz	± 30 kHz	± 50 kHz
Minimum slope at f_o	– 40 mV/kHz	– 25 mV/kHz	– 75 mV/kHz	– 20 mV/kHz
Non-linearity $\lambda \leq 1\%$ / $\lambda \leq 5\%$ / $\lambda \leq 10\%$	± 0,5 kHz ± 1,0 kHz ± 1,5 kHz	± 1,0 kHz ± 2,0 kHz ± 3,0 kHz	± 2,0 kHz ± 5,0 kHz ± 10,0 kHz	± 5,0 kHz ± 12,0 kHz ± 20,0 kHz
DC-Termination	100 k Ω	100 k Ω	100 k Ω	100 k Ω
Operable temperature range	– 20° C ... + 70° C		– 40° C ... + 80° C	

V.H.F. Filter XF410-S02

Centre Frequency	41.0 MHz	Poles	6
Bandwidth	7 KHz	Impedance	50 ohms
6:60 dB	1:2.9	Ripple	2 dB max
Ultimate Attn	60 dB min	Insertion Loss	6dB max
STOPBAND NOTCH @	59 MHz; 80 dB	"hole" over 14 KHz	

SPECTRUM INTERNATIONAL, INC.
P. O. Box 1084
CONCORD, MASSACHUSETTS 01742
U.S.A.





High Frequency Crystal Filters

mounting studs (threaded.

The standard range of KVG 9 MHz and 10.7 MHz crystal filters continues to be the most widely used and popular choice for both Amateur radio and commercial applications. KVG crystal filters and oscillator crystals are designed and manufactured to the highest commercial standards in a modern computer controlled factory. In use, they deserve their reputation of having almost "ZERO DEFECTS".

From simple oscillator circuits to FM, SSB and complex digital data applications, KVG crystal products will be found to perform as expected and to meet all published specifications.

In addition to the "standard" filters listed on pages 2 & 3, 2 pole and 4 pole miniature filters packaged in Hc6/u and Hc18/u crystal cans are also available. The 10.7 MHz 4 pole filter is designed for use in FM receivers; the 9 MHz 2 pole filter is used to remove wideband I.C. IF amplifier noise prior to signal detection.

Crystal discriminators at 9 MHz and 10.7 MHz are other products. These have tightly controlled characteristics which do not drift with age and temperature like classic LC discriminators. They are intended for ultra-linear FM detection, AFC circuits and for use in electronic measurement applications.

A number of non-standard designs are available on special order from the KVG factory catalogue.

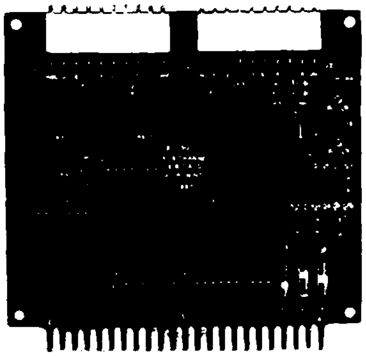
Figure 15. Notch filter.

BCC30

DATA SHEET

12 Bit A/D Converter Board

DESCRIPTION



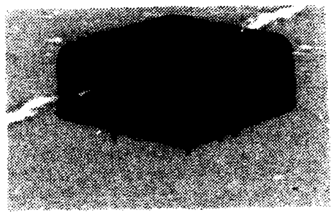
The Micromint BCC30 12 Bit Analog-to-Digital Converter board is a high speed sixteen channel unit designed for use with Micromint's family of Basic Computer/Controllers - the 8052-based BCC52, the Z8 BASIC BCC11, and the Z8 Forth BCC21. The BCC30 A/D board provides the ability to monitor up to eight differential (or 16 single ended) analog signals in bipolor (-5 to +5 volts) operation. Each of its eight channels of conversion has twelve bits of resolution (plus sign bit). Like the BCC13, the BCC30 A/D Converter board is memory mapped, so it is easily accessible from BASIC, Forth, or assembly language. No special routines are needed to configure the A/D board. A channel is chosen under software control and is then sampled. The A/D Converter processes 10,000 samples/second, with an input range of -5 to +5 volts. Multiple boards may be installed in a single system since the BCC30 can be configured to run at 128 predefined (jumper selectable) locations. The number of boards that may be run together is only subject to the limitations of the power supply and bus loading.

The 12 Bit A/D Board is ideal for applications where moderate speed and high resolution are necessary.

SPECIFICATIONS

- 16 single ended channels, or 8 differential channels
- bipolar operation:
  - -5 to +5 volts
- 12 bit resolution (plus sign bit): 1.2 millivolts
- up to 10,000 samples per second
- dual ported memory
  - occupies a 256 byte address space at one of 128 different addresses
- power supply requirements:
  - +5 volts @ 75 ma.
  - +12 volts @ 20 ma., -12 volts @ 7 ma
- operating conditions:
  - temperature: 0-50 C (32-122 F)
  - relative humidity: 10-90%, non-condensing
- dimensions and connections:
  - 4.5" x 4.375" board
  - dual 22 pin (0.156") edge connector
  - 2 x 10 pin Molex connectors (0.156")

Figure 16. A/D converter.



1 MHz - 630 MHz	
$\pm 2 \times 10^{-7}$ OVER 0/+50°C $\pm 5 \times 10^{-7}$ OVER -20/+70°C $\pm 1 \times 10^{-6}$ OVER -55/+85°C	
$1\text{-}2 \times 10^{-6}$/YEAR (DEPENDING UPON FREQUENCY)	
1 KHz	50 KHz
-130dBc/Hz	-145dBc/Hz
-140dBc/Hz	-160dBc/Hz

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Figure 17. Vectron 500 MHz crystal oscillator.

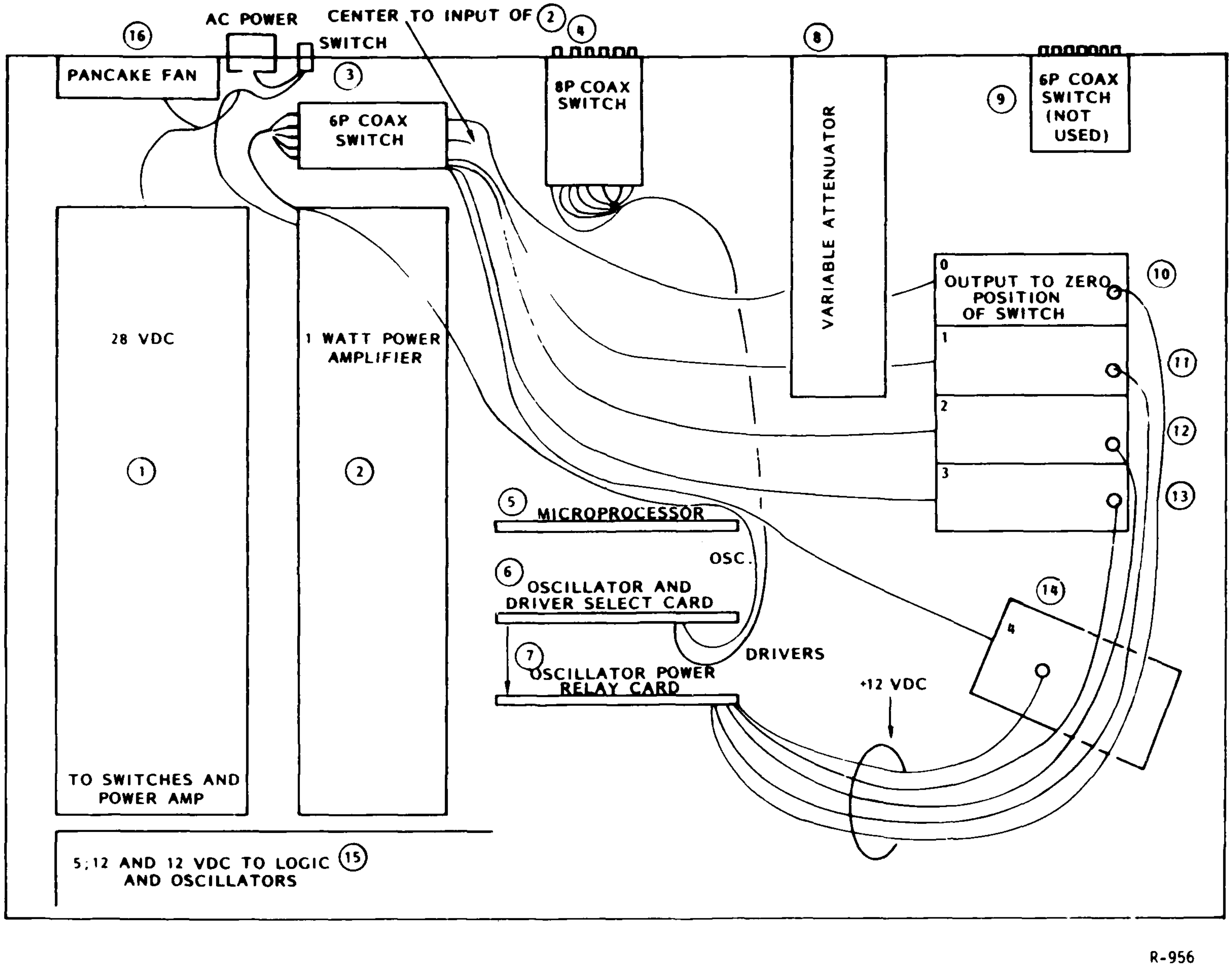

Figure 18. Transmitter detail.

TABLE 1. TRANSMITTER PARTS LIST/MANUFACTURER

Item	Element	Manufacturer/Part #
1	High current 28 V d.c. power supply	Lambda/Q5A28-20
2	1-watt RF power amplifier	AR/1W1000 OEM
3	6-position coaxial switch	RLC/SR-6C-D-TL
4	8-position coaxial switch	RLC/SR-8C-D-TL
5	Microprocessor	MicroMint Z8 controller/NA
6	Oscillator select card	MRC/NA
7	Oscillator power relay card	MRC/NA
8	Variable attenuator	KAY/NA
9	6-position coaxial switch	RLC/SR-6C-D-TL
10	100 kHz oscillator	MRC/NA
11	1 MHz oscillator	MRC/NA
12	30 MHz oscillator	MRC/NA
13	100 MHz oscillator	MRC/NA
14	509 MHz oscillator	MRC/NA
15	Low voltage power supply	Condor/TAA-16W
16	Ventilation fan	Archer/273-243

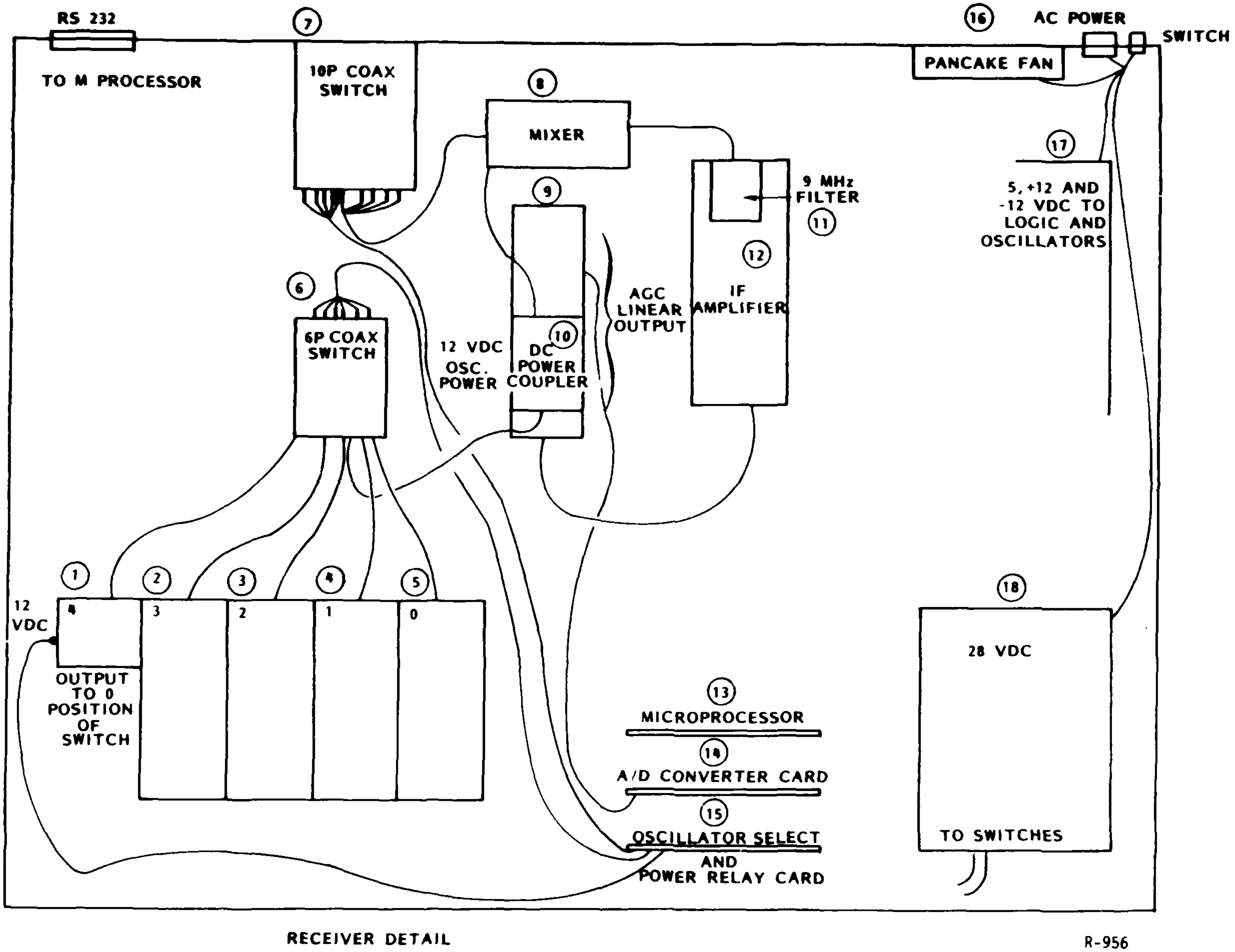

Figure 19. Receiver detail.

TABLE 2. RECEIVER PARTS LIST/MANUFACTURER

Item	Element	Manufacturer/Part #
1	500 MHz oscillator	Vectron/CO233FW 12VDC
2	109 MHz oscillator	MRC/NA
3	39 MHz oscillator	MRC/NA
4	10 MHz oscillator	MRC/NA
5	9.1 MHz oscillator	MRC/NA
6	6-position coaxial switch	RLC/SR-6C-D-TL
7	10-position coaxial switch	RLC/SR-10C-D-TL
8	RF mixer	MRC/NA
9	AGG circuit	MRC/NA
10	DC power coupler for oscillators	MRC/NA
11	9 MHz crystal filter	Spectrum Int'l/XF-910
12	IF amplifier	MRC/NA
13	Microprocessor	MicroMint Z8 controller/NA
14	A/D converter	MicroMint/BCC30
15	Oscillator select and 500 MHz power	MRC/NA
16	Ventilation fan	Archer/273-242
17	Low-voltage power supply	Condor/TAA-16W
18	28-volt power supply	Lambda/LM219

The coaxial switches are controlled to match the selections of the transmitter switches such that the transmitted signal can be locally detected. The transmitted signal enters the receiver via the sensor and switch at its input. The received signal is then mixed with the appropriate local oscillator and the resultant 9 MHz signal is filtered, removing unwanted harmonics. The filtered signal enters the AGC where it is amplified or attenuated, maintaining a constant signal amplitude. At this point the 9 MHz signal is no longer monitored. The attention of the system now goes to the AGC control voltage. The control voltage, generated by the AGC, responds linearly to the received signal and is d.c., a much better format for interpretation by the A/D converter. The A/D converter digitizes the AGC control voltage into "counts" and sends the counts to the microprocessor, which then equates these counts to a signal level in dBm (logarithmic millivolts into 50 Ω).

The computer/microprocessor control and recording subsystem is present in both the receiver and transmitter. The computer portion is an IBM-compatible Corona PC. The computer provides the source code for each of the microprocessors; it is also the controller and data output device. The microprocessors have sufficient memory and capability to work independently of the computer. This method of operation, however, would require major changes in the programing and hard memory additions to the system. This capability is beyond the scope of this present effort, and has been left as an option for later developmental efforts.

The computer is interfaced with the transmitter via fiber optics. The transmitter is configured for receive-only while the receiver can both receive and transmit information with the computer. Presently, the programming is configured to track a sensor and driver (located in pairs opposite each other) at matched frequencies. At a future time, it may be desirable to mismatch sensor/driver pairs in order to check for other paths of degradations. This would require minor change in the operating code.

The system initialization is prefaced by the proper configuration of the PC. To do this initialization, a batch routine is initiated so that the output ports of the computer can communicate with the receiver and transmitter. The receiver and transmitter are then turned on. Another batch routine loads the operating software into the system. Once the system is initialized, a calibration is done to check the linearity of the AGC to signal strength (in dBm) against fixed increments of attenuation. If the linearity of the system is good, the operator instructs the system to store the data for use later in converting measurement into decibels. Poor linearity requires recalibration and indicates potential system malfunction. Following calibration, the system acquires a baseline set of data for each test frequency and sensor/driver combinations desired. Once this is done, the system is ready to enter into the automatic mode, periodically measuring and reporting the attenuation status as dictated in the code.

The variable attenuator is used by the system to provide baseline information about the operation of the oscillators, RF amplifier, and AGC. The variable attenuator is used only to calibrate the system. The calibration is done using the microprocessor to control the attenuator while the transmitter functions normally. The signal is received and the AGC responds with a voltage that is proportional to each of the attenuation changes. For this procedure, the transmitter and receiver must be hardwired together through their calibration channel. The hardwiring of the channel can be done through an opening in the shield of the enclosure, but is better done with a coaxial feed-through in the enclosure's penetration panel. Once the calibration is complete, the cable must be removed and the feedthrough capped, to prevent degradation of the enclosure's integrity. During the calibration, the attenuator is stepped from maximum attenuation to minimum attenuation. The AGC voltage output is monitored and converted to binary counts. Each of these counts represents attenuation settings of the attenuator. The ratios of these counts are tabulated and converted to

dBm. This information is stored as a curve for the comparison of all data received in the normal operating mode.

The sensor/driver pairs are experimental in nature. Pairs were designed specifically for the type of degradation we generated in their vicinity. Thus, they may be somewhat insensitive to unexpected degradations. A more general sensor, which has a wider bandwidth, may be needed. The tradeoff is less sensitivity. Figure 20 provides the three varieties of folded inductors used during this program. Appendix A provides typical installation details.

The initial system tests conducted on two types of enclosures demonstrated system sensitivity. The first enclosure was a double-screen faraday enclosure manufactured by Lingren Enclosures. This enclosure provided the highest lattitude for intentional degradation. In addition to degrading the obvious penetrations--door, penetration panel, air filter, etc.--we were able to actually penetrate the walls of the enclosure with insulated wires. Preliminary tests on the system provided the necessary information for optimum probe locations. The second enclosure test evaluated the system performance on an S-250 shelter. There were no penetrations on the shelter as provided. The control and power lines for the receiver were routed through the floor drain pipe in a reasonable manner. The power was filtered and the control was via fiber optics. The only portion of enclosure tested was the doorway.

The data acquired during these two tests is presented in Appendix B. The two basic outputs for each of the tests is identical and a sample is given in Figure 21. Contained within the tables is the sensor type, location, and drive frequencies. This information must be kept in mind when reviewing the appendix, since a shorthand notation is used in the data output of the system.

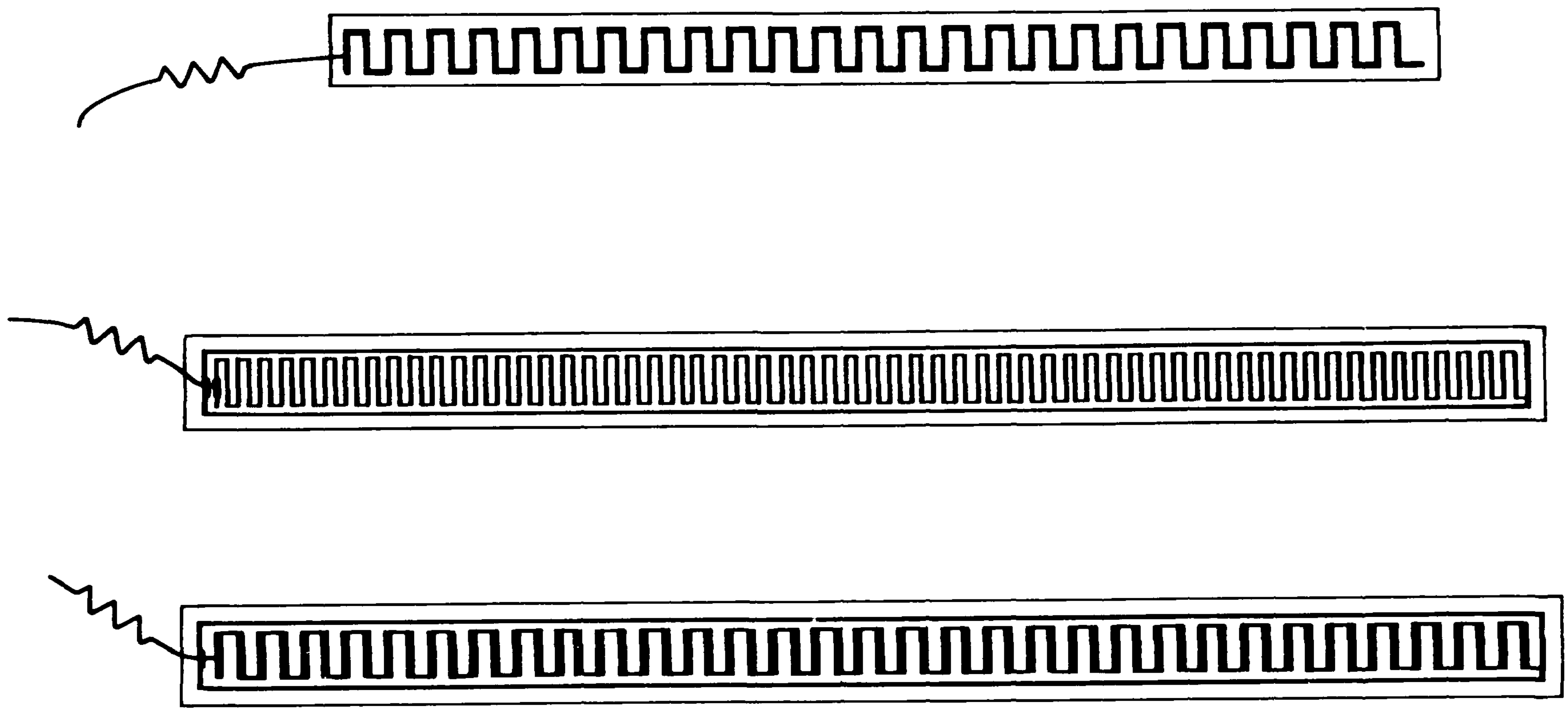

Figure 20. Folded inductors (sensor/driver).

	SENSOR/DRIVE ASSIGNMENTS CHANNEL						
FREQ.	1	2	3	4	5	6	7
100kHz 1	X	X	X	X	X	X	X
1MHz 1	X	X	X	X	X	X	X
30MHz 2	X	X	X	X	X	X	X
100MHz 3	X	X	X	X	X	X	X

\+ OR - ATTENUATION IN dB

\+ IS INCREASED ATTENUATION

\- IS DECREASED ATTENUATION

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Figure 21. Annotated data output.

c. System Specifications--Selected system specifications are presented below.

Sensitivity:	-110 dBm
Dynamic range:	110 dB
Time interval between full scan:	2 minutes (minimum)
Sensor/driver:	Inductive transducer, dipole, folded inductor (2:1, 10:1, and 20:1 cross drive ratio), direct wire
Output cables:	RG 58 coaxial cable with SMA terminations (one end)
Calibration penetrations:	SMA coaxial feedthrough
Power requirements:	120 V a.c., 2 amps
Full scan time:	1.5 minutes for 4 frequencies and 2 sensor/driver pairs

d. Operating Instructions--A general discussion of the operating fundamentals has already been presented. The startup and operation of the system is a rather simple task and is shown in the flowchart of Figure 22. Notes on modification to the present program to suit more specific needs are presented in Appendix C along with a complete listing of the operating program.

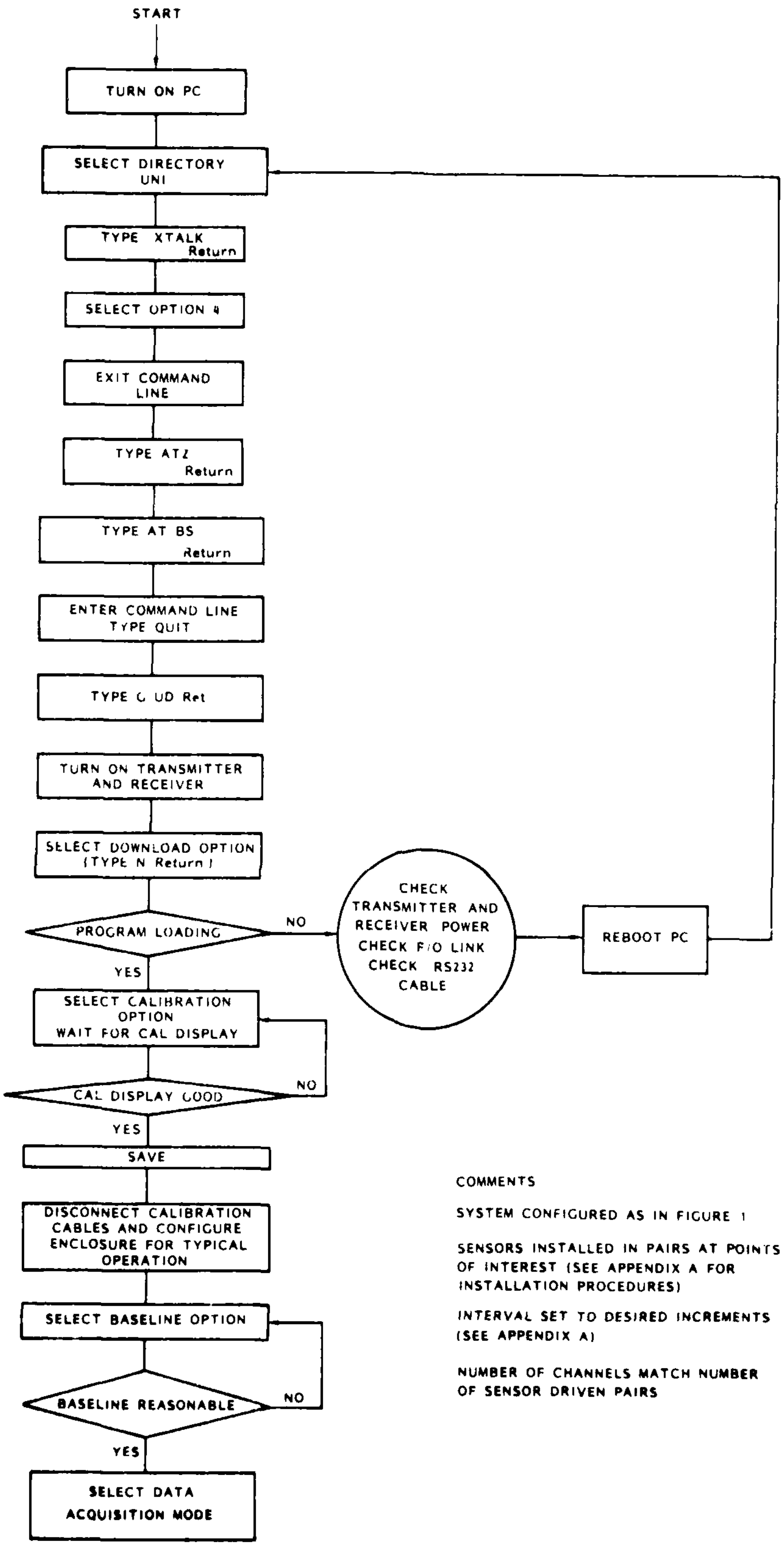

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Figure 22. System operation flow chart.

III. CONCLUSION

1. CONCLUSION OF PRESENT EFFORT

The present effort has developed a complete automated hardness assurance monitoring system covering the band of 100 kHz to 500 MHz. The designs implemented are based on highly reliable old technology. The components used have been easily procured in a reasonable time frame and have been found in most cases to be adequate for use without modification. The system has worked well in the laboratory with continuous operation in excess of 72 hours. The physical design of the system has not been ruggedized and therefore is not for field use.

A hand-held, 12 GHz "sniffer" has been developed for use in localizing leaks detected by the HAMS. The sniffer is battery powered and capable of determining the magnitude of the leak within a 2 dB tolerance.

2. SUGGESTED HAMS USAGE

Shelterized systems require periodic maintenance and/or upgrading and refurbishment. These major maintenance functions are performed at the depot or logistics center level of maintenance. We suggest that the HAMS be utilized during depot maintenance to determine actual shelter shielding performance. Serious shielding deficiencies can be found and corrected promptly and efficiently, given the full resources of the depot. Additionally, the shielding performance of each tested shelter will form a data base of actual shielding performance as a function of time (and shelter usage).

Presently, this data is either very sparse or non-existent. Consequently, the time period for shielding-specific maintenance is subject to great uncertainty. The HAMS data will provide an empirical foundation for the development (or refinement) of periodic shielding maintenance

requirements. This will enhance user confidence that shelter shielding will be there when it's needed.

Actual data gathering at the depot should be as automated as possible. Sensors would be installed by the shelter manufacturer during shelter fabrication. Depot/logistics center personnel would then connect the HAMS mainframe components to the sensors, punch a few buttons to initialize the sytem, and follow a simple menu to collect actual shielding effectiveness data. The HAMS cannot support such automated functions as presently configured, but such capability is a natural extension of the existing prototype system.

In the electromagnetic interference/electromagnetic capability (EMI/EMC) testing communities, it is common practice to use sniffers (one low frequency and one high frequency) to check shelter performance. They have found that if the shelter performs adequately at the end points of the required frequency range, it "usually" performs adequately at other intermediate frequencies.

The HAMS sniffer provides a simple, compact means to determine shielding performance at high frequencies, specifically 12 GHz. This capability can be used, especially at the field level of activity, to get an immediate indication of the high-frequency shielding performance of the shelter. Given the current interest in high-frequency electromagnetic effects, e.g. microwaves, the ability to determine high-frequency shielding in the field is all the more desirable.

3. RECOMMENDATIONS FOR FUTURE WORK

The HAMS developed by this effort emphasizes the status of the shield. We did investigate inductive coupling to the input cables of the power filter in an effort to monitor filter performance. The drivers used to induce energy on the input cables and measure signals on the output cables did not show sufficient sensitivity to allow monitoring of the

filter. Approaches proposed by Rockwell International (Ref. 3) for the Air Force Weapons Laboratory should be considered for monitoring of filters and surge arresters. These techniques directly drive filters and surge arresters to measure their performance. This increased capability comes at the expense of additional HAMS complexity and decreased life-cycle performance of the penetration protection devices (surge arresters will "fire" a large, but finite, number of times before failing).

A minimal effort was devoted to sensor/driver development under this program. We also chose operating frequencies to conveniently cover the band of interest. A fruitful, future endeavor would be the investigation of operating frequencies of interest to deployed shelters. This effort should be combined with a sensitivity study of sensors/drivers, to ensure maximum dynamic range of these elements at the chosen operating frequencies. Any study of operating frequencies should also consider the issue of EM signatures. An operating HAMS must not emit EM signals which would allow an adversary to "lock-on" to an important communication/intelligence asset.

The prototype system should be presented to several electronic equipment manufacturers for discussions concerning "militarization" of the prototype HAMS. We believe that we have chosen a fairly simple, rugged design, but we are not in the hardware business.

The operating procedures for the prototype system could be streamlined. Possible enhancements include elimination of the external personal computer by using integral microprocessors in the receiver and transmitter, keypad control, user-friendly software, and "burned-in," permanent software.

REFERENCES

1. Trybus, P. R., and G. F. King, Final Report on the Development of an EMI/RFI Detection System, AMRC-R-698, Mission Research Corp., April 1985.

2. McCormack, Ray G., Christopher Hahin, Richard Lampo, and Paul Sonnenburg, Study of EMI/RFI Shielding of Tactical Shelters, ESL-TR-80-24, Construction Engineering Research Laboratory, April 1980.

3. Technical Staff, Rockwell International, Continued Development of HAMS - Phase I Final Report, C^3AT-5-RI-115, Mission Research Corp., January 1987.

APPENDIX A
SENSOR/DRIVER INSTALLATION

This appendix provides information necessary for the proper installation of sensor/driver pairs. At this time, two basic sensors are recommended for use with this system. The first sensor type was developed by MRC for this program. This sensor is called the folded inductor. The folded inductor is intended for use with slotted apertures. When installed, it should run parallel to the slot. It should be installed as close to the slot as possible without degrading the RF gaskets used to seal the slot. The sensor is etched on printed circuit material that allows the sensor, in most cases, to be placed partially into the flange areas next to the gaskets. Figure A1 depicts a typical installation. The sensor and driver should always be installed symmetrically across the potential penetration.

The second sensor is simply the short circuit sensor of Figure A2. This method is used for the general sensing of degradations in penetration panels, wall panels, and honeycomb panels. Diagonal corners of the panels are used as the attach points. The center conductor is attached to one corner while the shield is attached to the other.

The sensor/drivers should be attached to the surface of the enclosure with solder or bolts, via their grounds or terminating resistors. To ensure that the sensor or driver remain stationary, it is recommended that they be secured in place with a wide strip of waterproof tape. This will also help prevent corrosion of the sensor.

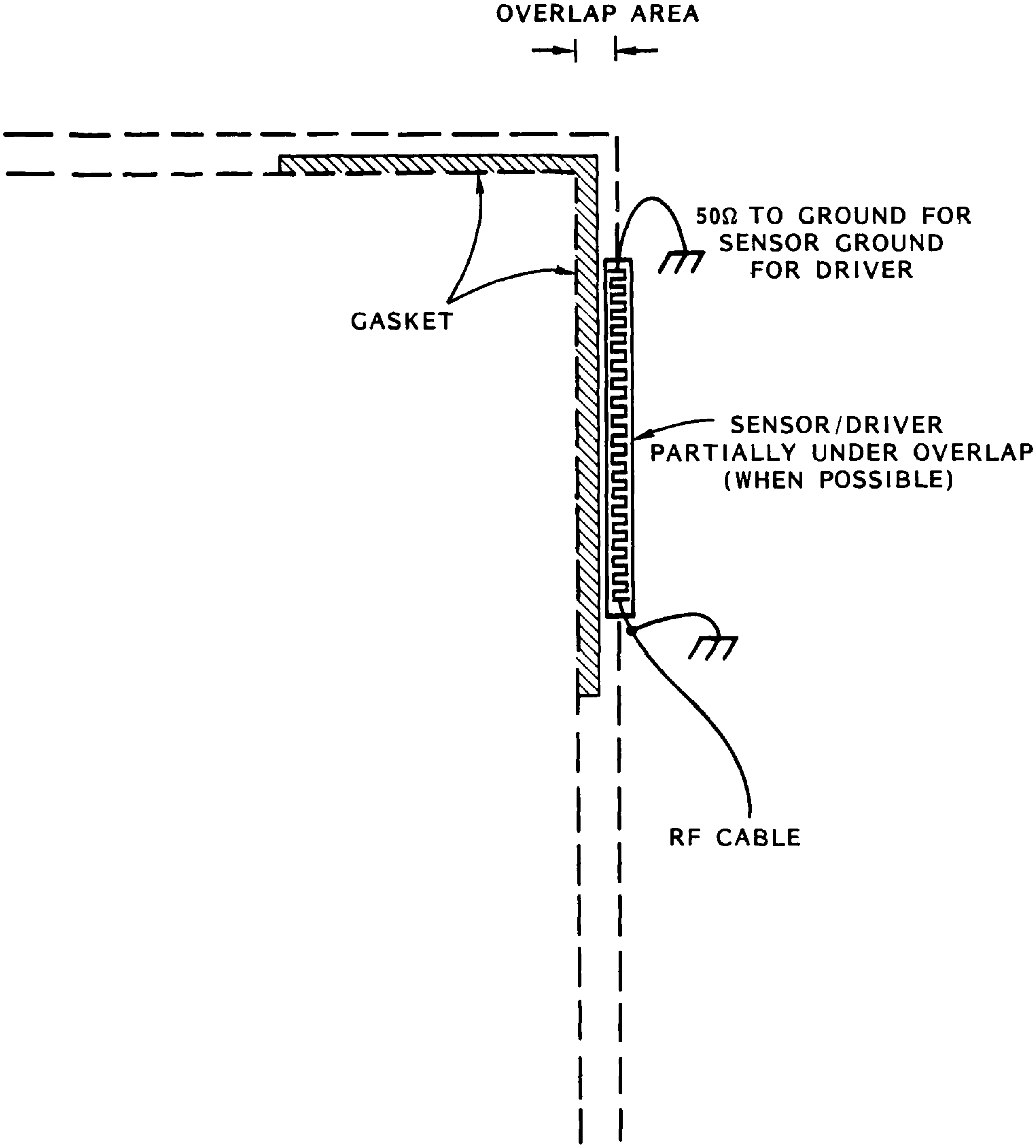

Figure A1. Typical door sensor/driver.

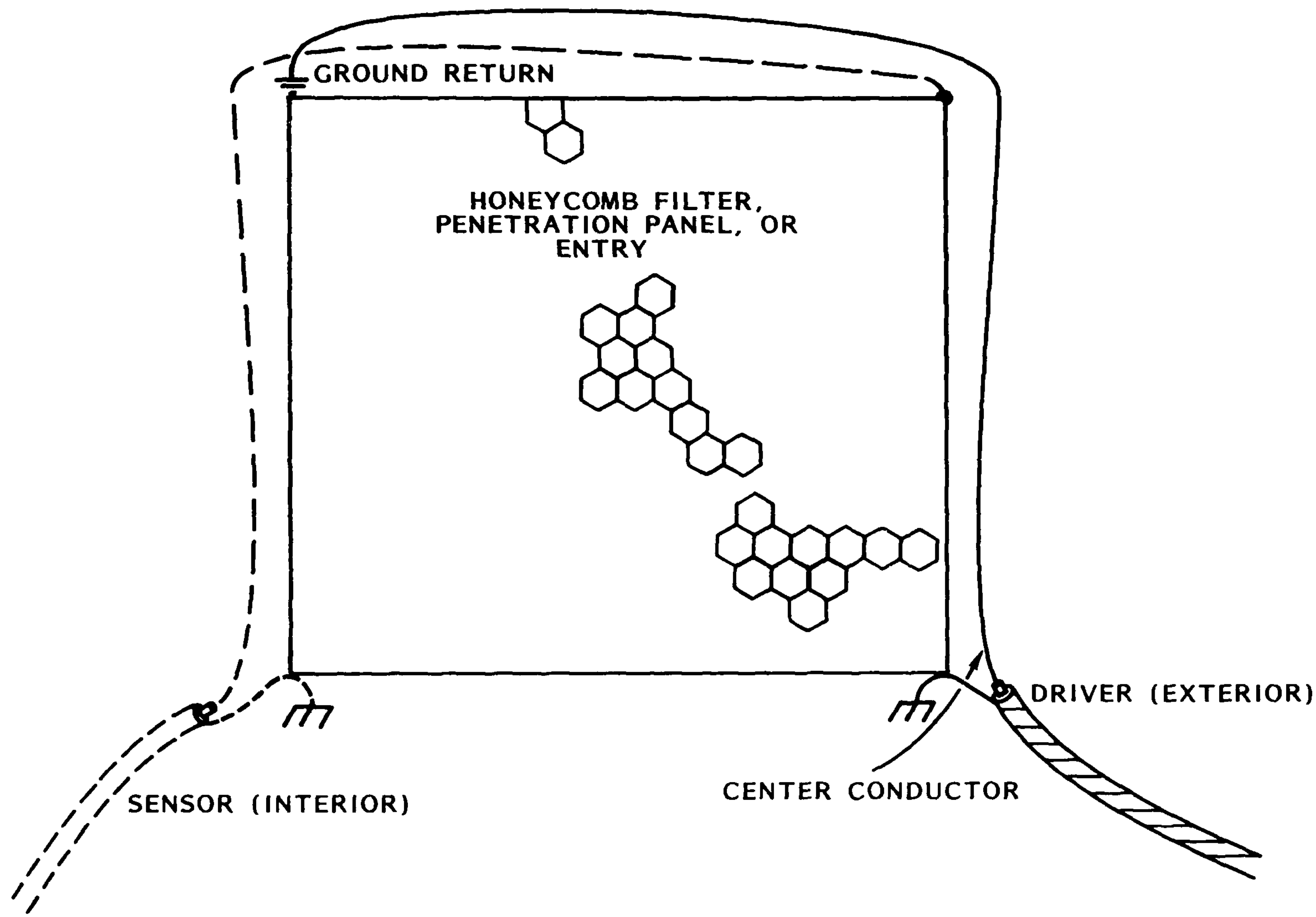

Figure A2. Short circuit drive.

APPENDIX B

S250 SHELTER DATA
AND
LINGREN SCREEN ROOM DATA

The following data sheets show data acquired on the S-250 shelter. The first entry shows the baseline measurements. The data entries are the attenuations (in dB) of driven sensor vs. received sensor. See Figure B1 for sensor/drive placement. The data following the baseline information shows variations from the baseline set of data. Some variation is evident as the system warms up, as seen in the data on pages B3 through B7; however, the variance is less than 6 dB. We have found that a recalibration after a warm-up period usually removes this instability.

When we put paper in the outer door, only the 100 MHz folded inductor combination detected the degradation, as seen on pages B8 and B9. The system was unable to detect an open inner door, probably because no sensors were installed there.

The very last data set shows that the folded inductor detected an open outer door for all frequencies, while the short circuit sensor only saw an open door for the higher frequencies (30 MHz and 100 MHz).

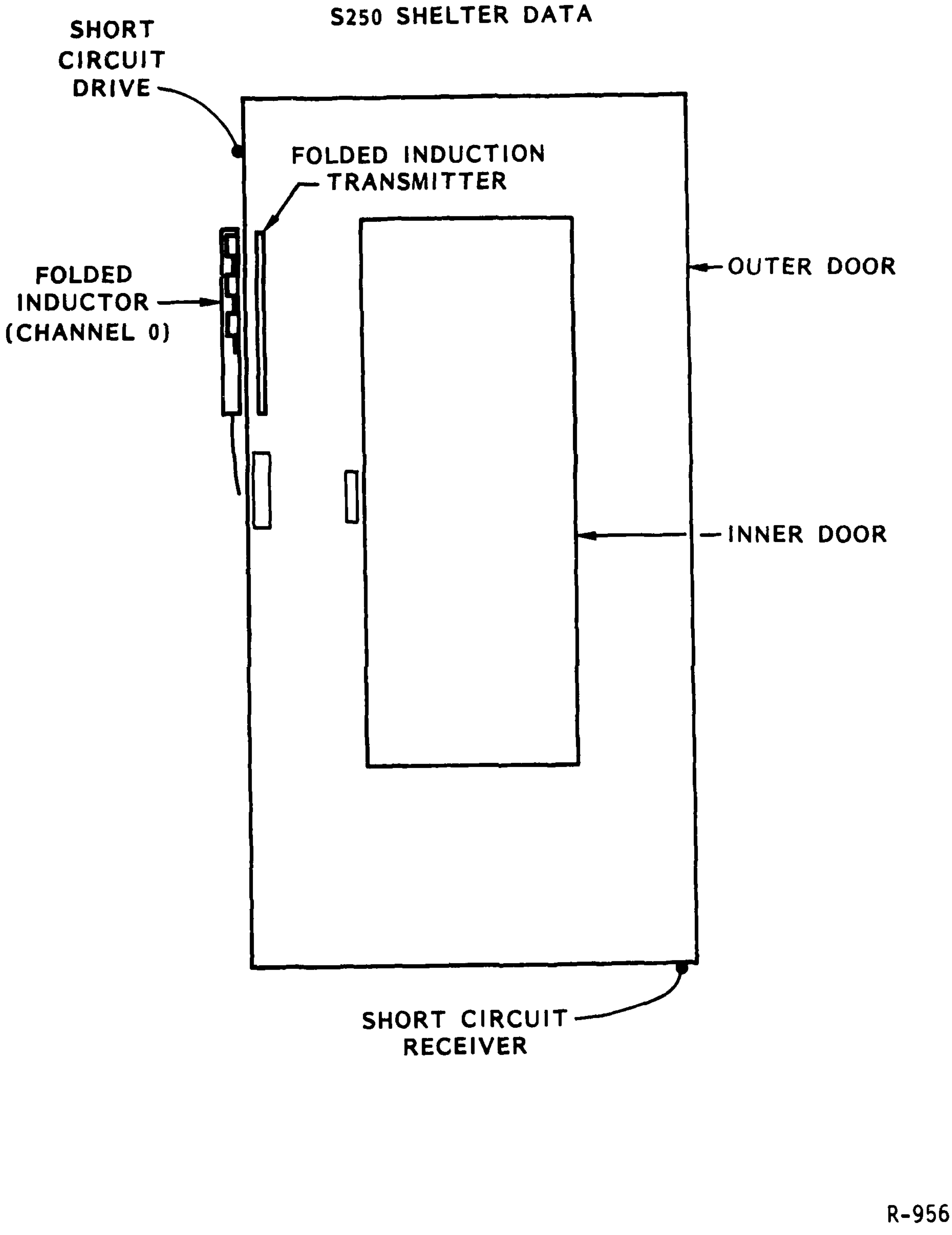

Figure B1. Sensor/driver placement, channel 0.

BASELINE DATA

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:21:46 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	92	83
1 MHz	80	93
30 MHz	66	111
100 MHz	92	100

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:23:11 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	-1
1 MHz	0	0
30 MHz	0	0
100 MHz	0	0

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:24:56 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	-1
1 MHz	0	0
30 MHz	0	0
100 MHz	1	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:26:41 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	0
1 MHz	0	1
30 MHz	0	0
100 MHz	3	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:28:25 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	0
1 MHz	0	1
30 MHz	0	0
100 MHz	5	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:30:10 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	0
1 MHz	0	1
30 MHz	0	0
100 MHz	5	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:31:55 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	-1
1 MHz	0	1
30 MHz	0	0
100 MHz	4	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:33:40 03-16-1987

CHANNEL FREQ	**Folded Inductor**	**Short Circuit**
100 kHz	0	0
1 MHz	0	1
30 MHz	0	0
100 MHz	2	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:35:25 03-16-1987

CHANNEL FREQ	**Folded Inductor**	**Short Circuit**
100 kHz	0	0
1 MHz	0	1
30 MHz	0	0
100 MHz	0	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:37:09 03-16-1987

CHANNEL FREQ	**Folded Inductor**	**Short Circuit**
100 kHz	0	0
1 MHz	0	1
30 MHz	0	0
100 MHz	-1	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:38:54 03-16-1987

CHANNEL FREQ	**Folded Inductor**	**Short Circuit**
100 kHz	0	0
1 MHz	1	1
30 MHz	0	0
100 MHz	-1	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:40:39 03-16-1987

CHANNEL FREQ	**Folded Inductor**	**Short Circuit**
100 kHz	0	-1
1 MHz	0	0
30 MHz	0	0
100 MHz	-3	-1

CURRENT VARIATION FROM BASELINE **(Paper In Door)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:42:23 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-2	0
1 MHz	-2	1
30 MHz	-3	0
100 MHz	-23	-1

CURRENT VARIATION FROM BASELINE **(Paper In Door)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:44:08 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-2	0
1 MHz	-3	1
30 MHz	-2	0
100 MHz	-23	-1

CURRENT VARIATION FROM BASELINE **(Paper In Door)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:45:53 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-2	0
1 MHz	-3	1
30 MHz	-2	0
100 MHz	-23	-1

CURRENT VARIATION FROM BASELINE (Paper In Door)

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:47:38 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-2	0
1 MHz	-3	1
30 MHz	-2	0
100 MHz	-23	-1

CURRENT VARIATION FROM BASELINE (Paper In Door)

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:49:23 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-2	1
1 MHz	-3	1
30 MHz	-2	0
100 MHz	-23	-1

CURRENT VARIATION FROM BASELINE (Paper In Door)

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:51:07 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-2	-2
1 MHz	-3	0
30 MHz	-2	0
100 MHz	-23	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:52:52 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-1	1
1 MHz	-1	1
30 MHz	-2	0
100 MHz	0	-3

CURRENT VARIATION FROM BASELINE **(Inner Door Open)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:54:37 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	0
1 MHz	1	1
30 MHz	1	0
100 MHz	0	-5

CURRENT VARIATION FROM BASELINE **(Inner Door Open)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:56:21 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	0
1 MHz	1	1
30 MHz	1	0
100 MHz	1	-5

CURRENT VARIATION FROM BASELINE **(Inner Door Open)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:58:06 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	0	1
1 MHz	1	2
30 MHz	1	-1
100 MHz	-1	-1

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:59:50 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-1	0
1 MHz	1	1
30 MHz	1	0
100 MHz	1	-2

CURRENT VARIATION FROM BASELINE **(No Degradations)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:01:35 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-1	0
1 MHz	0	1
30 MHz	1	0
100 MHz	0	2

CURRENT VARIATION FROM BASELINE **(Outer Door Open)**

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:03:20 03-16-1987

CHANNEL FREQ	Folded Inductor	Short Circuit
100 kHz	-43	-4
1 MHz	-32	-3
30 MHz	-36	-31
100 MHz	-39	-13

LINGREN SCREEN ROOM DATA

Figures B2 through B4 show the location of the various sensors installed on the Lingren screen room. Two types of folded inductors were used: those produced by Farand Industries and those etched locally by MRC. The designation "MRC 2:1" means a folded inductor made by MRC with the given horizontal to vertical ratio.

The data format follows that shown for the S-250. Most of the data presented here show results of continuous operation of the system for more than 24 hours (note time and date entries). Note that very little variation with time was observed.

As with the S-250 shelter, the higher frequencies show the most sensitivity to degradation.

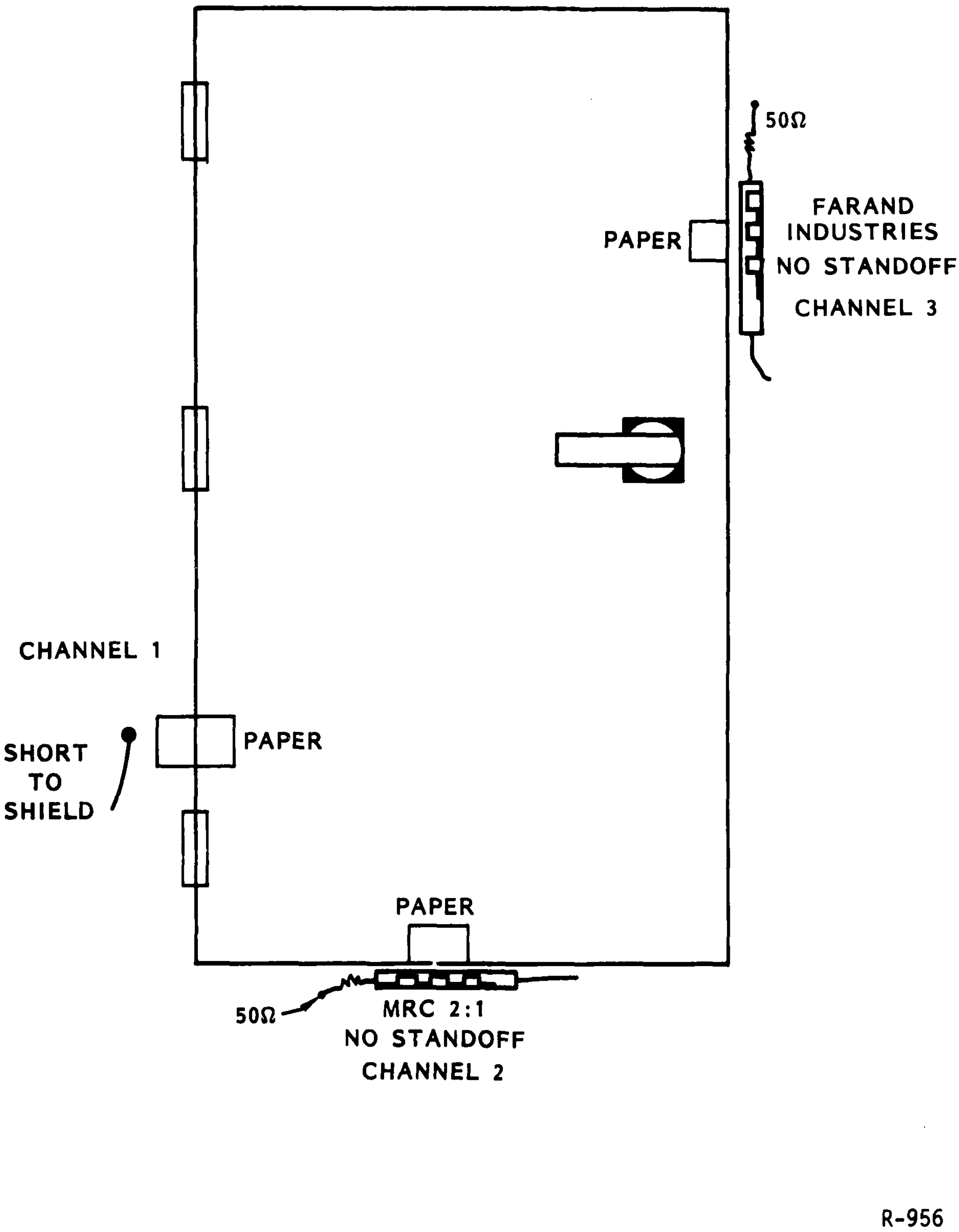

Figure B2. Channels 1, 2, and 3; Lingren enclosure.

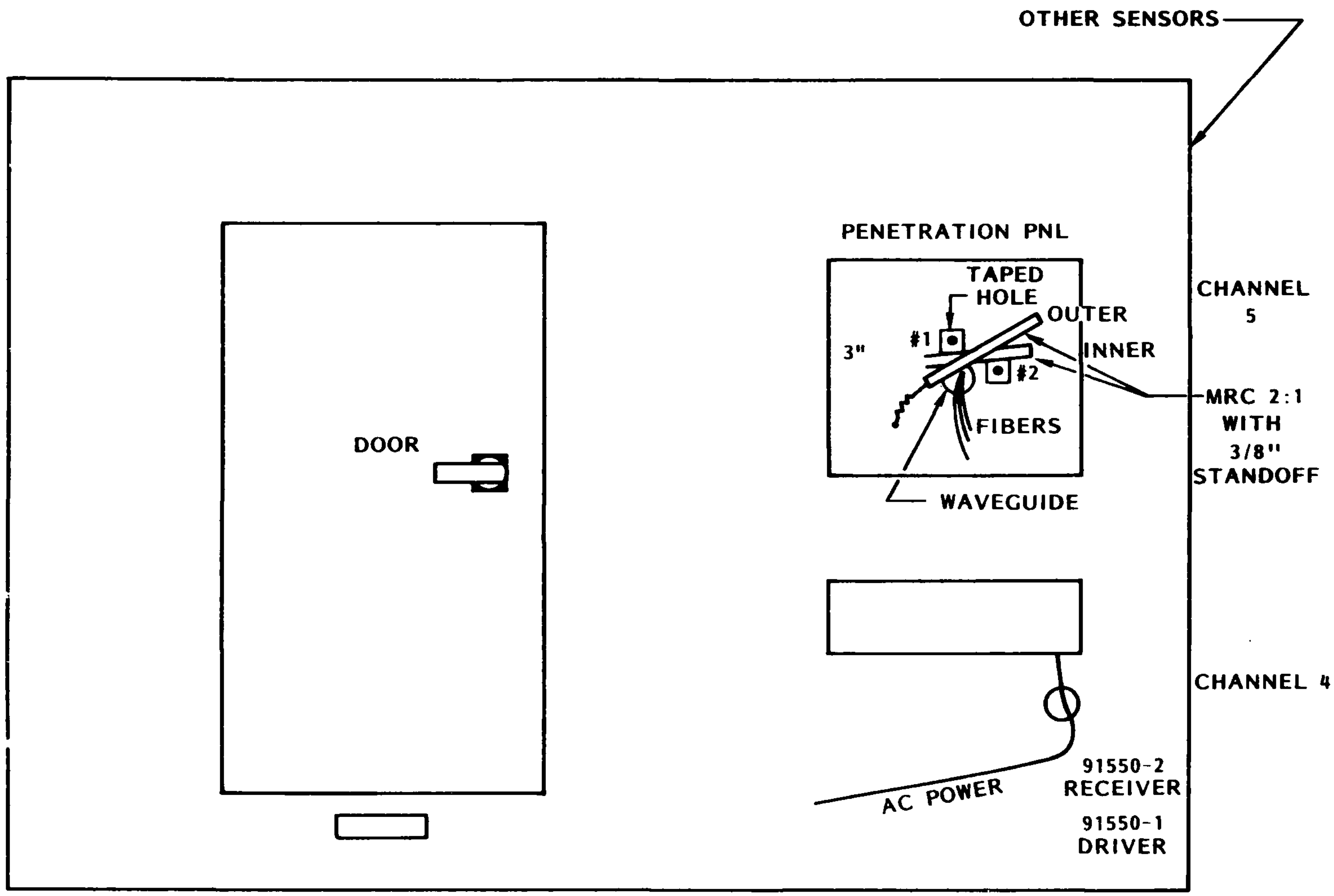

Figure B3. Channels 4 and 5; Lingren enclosure.

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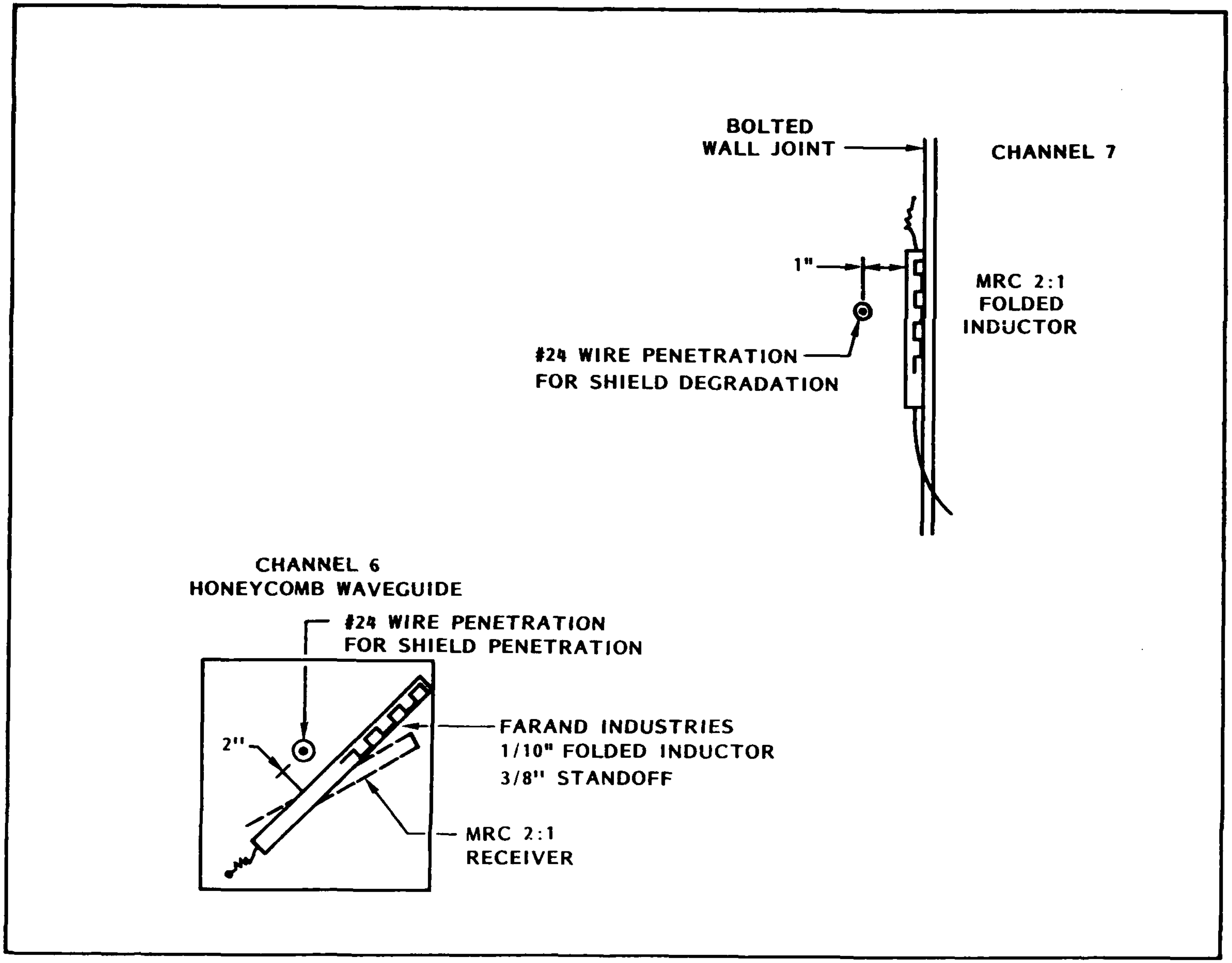

Figure B4. Channels 6 and 7; Lingren enclosure.

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Print out of BASELINE% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:13:23 02-05-1987

(Door open, wire in HC; cal. wire through door)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	93	107	107	107	107	107	107
1 MHz	70	92	92	99	107	107	107
30 MHz	21	62	65	65	107	91	69
100 MHz	50	86	90	89	107	107	107

Print out of BASELINE% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:17:41 02-05-1987

(Door open, no wire; cal. wire through door)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	93	107	107	107	107	107	107
1 MHz	70	92	92	99	107	107	107
30 MHz	20	62	65	64	107	90	68
100 MHz	49	86	90	90	107	107	107

Print out of BASELINE% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:21:59 02-05-1987

(Door open; cal. wire near sensor 4)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	93	107	107	107	107	107	107
1 MHz	70	92	92	99	107	107	107
30 MHz	20	62	65	65	107	107	107
100 MHz	49	85	90	88	107	107	107

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:27:03 02-05-1987

(Door closed)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	107	107	107	107	107	107	107
1 MHz	107	107	107	107	107	107	107
30 MHz	103	107	107	107	107	107	107
100 MHz	107	107	107	107	107	107	107

Print out of BASELINE% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:31:46 02-05-1987

(Door closed)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	107	107	107	107	107	107	107
1 MHz	107	107	107	107	107	107	107
30 MHz	102	107	107	107	107	107	107
100 MHz	107	107	107	107	107	107	107

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:36:13 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:49:21 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:02:29 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:15:37 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:28:44 02-05-1987

(Baseline, no mods)

CHANNEL	1	2	3	4	5	6	7
FREQ	**Door**	**Door**	**Door**	**AC**	**PP**	**HC**	**Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:41:52 02-05-1987

(Baseline, no mods)

CHANNEL	1	2	3	4	5	6	7
FREQ	**Door**	**Door**	**Door**	**AC**	**PP**	**HC**	**Wall Joint**
100 kHz	0	0	0	0	0	0	0
MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:55:00 02-05-1987

(Baseline, no mods)

CHANNEL	1	2	3	4	5	6	7
FREQ	**Door**	**Door**	**Door**	**AC**	**PP**	**HC**	**Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:08:08 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:21:16 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:34:23 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:47:31 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 16:00:39 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 16:13:46 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-3	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 16:26:54 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 16:40:02 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 16:53:10 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 17:06:17 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 17:19:25 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 17:32:33 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-2	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 17:45:40 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 17:58:43 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 18:11:56 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 18:25:03 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 18:38:11 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 18:51:19 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 19:04:26 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 19:17:34 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 19:30:42 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 19:43:49 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 19:56:57 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 20:10:05 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 20:23:12 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 20:36:20 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 20:47:28 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 21:02:35 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 21:15:43 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 21:28:51 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 21:41:59 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 21:55:06 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 22:08:14 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-3	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 22:21:22 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 22:34:29 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 22:47:37 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 23:00:45 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 23:13:53 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 23:27:00 02-05-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 23:40:08 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 23:53:16 02-05-1987

(Baseline, no mods)

CHANNEL FREQ	1	2	3	4	5	6	7
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 00:06:23 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1	2	3	4	5	6	7
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 00:19:31 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 00:32:39 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 00:45:46 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 00:58:54 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 01:12:02 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 01:25:10 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1	2	3	4	5	6	7
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 01:38:17 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 01:51:25 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 02:04:33 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 02:17:40 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 02:30:48 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 02:43:56 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 02:57:04 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 03:10:11 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 03:23:19 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 03:36:27 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 03:49:35 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 04:02:42 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 04:15:50 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 04:26:58 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 04:42:05 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 04:55:13 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 05:08:21 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 05:21:28 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 05:34:36 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 05:47:44 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 06:00:51 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 06:13:59 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 06:27:07 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 06:40:15 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 06:53:22 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 07:06:30 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 07:19:38 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 07:32:46 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 07:45:53 02-06-1[illegible]87

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 07:59:01 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 08:12:09 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 08:25:17 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 08:38:24 02-06-1987

(Baseline, no mods)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 08:51:32 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 09:04:40 02-06-1987

(Wire placed in HF honeycomb)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	-9	0
100 MHz	0	0	0	0	0	-14	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 09:17:48 02-06-1987

(Paper in door over sensor 3)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	-3	0	0	0	0
100 MHz	0	0	-9	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 09:30:55 02-06-1987

(Paper in door over sensor 2)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows:!

MRC/UD SHIELD ROOM MONITOR SYSTEM 09:44:03 02-06-1987

(Paper in door, sensor 1)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 09:57:11 02-06-1987

(Wire through hole, sensor 1; 6" extension)

CHANNEL FREQ	1 **Door**	2 **Door**	3 **Door**	4 **AC**	5 **PP**	6 **HC**	7 **Wall Joint**
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	-27	0	0
100 MHz	0	0	0	0	-32	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 10:10:17 02-06-1987

(Wire through shield, sensor 7)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	-23
100 MHz	0	0	0	0	0	0	-11

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 10:23:26 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 10:36:34 02-06-1987

(Sensor 5, no tape backing wire)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 10:49:42 02-06-1987

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

(Paper in door 1 diam. above sensor 3;
wire through feedthrough F/0, 1" extension both sides)

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 11:02:50 02-06-1987

(4 ft BNC cable through F/0 feedthrough)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-13	0	0	0	0	0	0
100 MHz	-26	0	0	0	-5	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 11:15:58 02-06-1987

(4 ft BNC cable through F/0 feedthrough)

CHANNEL / FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-13	0	0	0	0	0	0
100 MHz	-27	0	0	0	-5	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 11:29:05 02-06-1987

(Paper in door sensor 2; drive short circuit; receiver 50 Ω load)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 11:42:13 02-06-1987

(Paper in door sensor 3; drive short circuit; receiver open circuit)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	-9	0	0	0	0
100 MHz	0	0	-6	0	0	0	0

MRC/UD SHIELD ROOM MONITOR SYSTEM 11:55:21 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-2	-1	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 12:03:28 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	-1	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 12:21:36 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 12:34:43 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 12:47:51 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:00:58 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:14:06 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-2	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:27:13 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	0	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:40:21 02-06-1987

(Baseline, no mods)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 13:53:27 02-06-1987

(Fluorescent light in room turned on)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:06:36 02-06-1987

(Fluorescent light in room turned on)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	-1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:19:44 02-06-1987

(Door opened)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	-6	0	0	0	0	0	0
1 MHz	-31	-15	-16	-7	0	0	0
30 MHz	-63	-45	-42	-17	0	0	0
100 MHz	-47	-22	-15	-18	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:32:53 02-06-1987

(Door opened)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	-6	0	0	0	0	0	0
1 MHz	-31	-15	-16	-7	0	0	0
30 MHz	-63	-45	-42	-17	0	0	0
100 MHz	-47	-22	-15	-18	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:46:01 02-06-1987

(Door opened)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	-6	0	0	0	0	0	0
1 MHz	-31	-15	-16	-7	0	0	0
30 MHz	-63	-45	-42	-17	0	0	0
100 MHz	-47	-22	-15	-18	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 14:59:09 02-06-1987

(Door opened)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	-6	0	0	0	0	0	0
1 MHz	-31	-15	-16	-7	0	0	0
30 MHz	-63	-45	-42	-17	0	0	0
100 MHz	-47	-22	-15	-18	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:12:17 02-06-1987

(Door opened)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	-6	0	0	0	0	0	0
1 MHz	-31	-15	-16	-7	0	0	0
30 MHz	-63	-45	-42	-17	0	0	0
100 MHz	-47	-22	-15	-18	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:25:25 02-06-1987

(Door opened)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	-6	0	0	0	0	0	0
1 MHz	-31	-15	-16	-7	0	0	0
30 MHz	-63	-45	-42	-17	0	0	0
100 MHz	-47	-22	-16	-18	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:38:34 02-06-1987

(Door opened)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	-8	0	0	0	0	0	0
1 MHz	-33	-11	-22	-7	0	0	0
30 MHz	-63	-42	-43	-17	0	0	0
100 MHz	-51	-35	-16	-9	0	0	0

Print out of RESULT% array follows!!

MRC/UD SHIELD ROOM MONITOR SYSTEM 15:51:41 02-06-1987

(Door closed, transmitter off)

CHANNEL FREQ	1 Door	2 Door	3 Door	4 AC	5 PP	6 HC	7 Wall Joint
100 kHz	0	0	0	0	0	0	0
1 MHz	0	0	0	0	0	0	0
30 MHz	1	0	0	0	0	0	0
100 MHz	0	0	0	0	0	0	0

APPENDIX C
SYSTEM SOURCE CODE

This appendix provides a hard copy of the working code. Incorporated within the code are several comments and sample changes that the user may implement or use as guides for customizing the program. The code presented in this appendix has minor changes over the code used in the operation of the system. One change is simply the deletion of some print characters, since the word processing system interprets them as control characters, and the other is the breaking of code lines in order to enable the printer to print all of one line. The code used by the system is filed UD.BAS, while the code presented here is filed UD.&BA

```
10 '                                              SAVE "ud.bas",A
20 OPTION BASE 0
30 SCREEN 105
40 CLS
50 LOCATE 12,19: PRINT "Enter B for box display or S for statements";
60 INPUT Z$
70 IF Z$="B" OR Z$="b" THEN PR%=0: GOTO 100
80 IF Z$="S" OR Z$="s" THEN PR%=1: GOTO 120
90 GOTO 40
100 LOCATE 6,27: PRINT "INITIALIZATION IN PROGRESS"
110 LOCATE 15,33: PRINT "Please wait"
120 DIM A$(255) 'used for command buffer string
130 RX%=1: TX%=2 'port numbers
140 DIM R%(3), T%(3), R$(4), T$(4) 'control register images
144  MOST%=0 'highest power used
145  LEAST%=110 'lowest power used
146  'This routine specifies the desired frequencies and channels.
147  'Both are counted from 0, i.e. freq%=3 will provied the first
148  'four frequencies. Remember to make the channel numbers agree
149  'with those in lines 3450 and 3490
150 FREQ%=3: CHANNEL%=1 'max count of each
160 DIM BASELINE%(FREQ%,CHANNEL%),
RESULT%(FREQ%,CHANNEL%),RP%(FREQ%,CHANNEL%)
170 DIM CAL%(157) 'AGC calibration data array
180 IF PR%=0 THEN LOCATE 9,38: PRINT ""
190 OPEN "com1:4800,N,8,1,cs,ds" AS #1 'receiver controller
200                 PRINT "BYPASS DOWNLOAD?  <Y or N>":INPUT Z$
210                 IF Z$="Y" OR Z$="y" THEN 830
220 '     Download receiver program
230 PORT%=RX%
240 A$="190 @%F6=0": GOSUB 2120
250 A$="200 @%E000=%FF: @2=%F: @2=0": GOSUB 2120
260 A$="210 INPUT R,V": GOSUB 2120
270 A$="220 IF R=9 GOTO 280": GOSUB 2120
280 IF PR%=0 THEN LOCATE 9,38: PRINT ""
290 A$="230 IF R<0 GOTO 300": GOSUB 2120
300 A$="240 IF R>3 GOTO 300": GOSUB 2120
310 A$="250 IF V<0 GOTO 300": GOSUB 2120
320 A$="260 IF V>255 GOTO 300": GOSUB 2120
330 A$="270 GOTO 310": GOSUB 2120
340 IF PR%=0 THEN LOCATE 9,38: PRINT ""
350 A$="280 IF V=0 GOTO 390": GOSUB 2120
360 A$="290 IF V=1 GOTO 390": GOSUB 2120
370 A$="300 PRINT "+CHR$(34)+"E"+CHR$(34)+": GOTO 210": GOSUB 2120
380 A$="310 IF R=0 THEN G=1": GOSUB 2120
390 A$="320 IF R=1 THEN G=2": GOSUB 2120
400 IF PR%=0 THEN LOCATE 9,38: PRINT ""
410 A$="330 IF R=2 THEN G=4": GOSUB 2120
420 A$="340 IF R=3 THEN G=8": GOSUB 2120
```

```
430 A$="360 @%E000=V: @2=G: @2=0": GOSUB 2120
440 A$="370 PRINT "+CHR$(34)+"0"+CHR$(34)+"": GOSUB 2120
450 A$="380 GOTO 210": GOSUB 2120
460 IF PR%=0 THEN LOCATE 9,38: PRINT ""
470 A$="390 N=%D000: @N=V+%10: @N=V: D=@N: E=@N": GOSUB 2120
480 A$="400 PRINT (D*256)+E,D,E: GOTO 210": GOSUB 2120
490 A$="RUN":GOSUB 2120
500 '     Set com2 to 1200 baud, 8, 1, and none
510 'OUT &H2FB,&H80 'set DLAB high
520 'OUT &H2F8,&H60 'set LSB of divisor
530 'OUT &H2F9,0 'set MSB of divisor
540 'OUT &H2FB,&H33 'set DLAB low, 8 data bits, no parity (?), 1 stop bit
550 IF PR%=0 THEN LOCATE 9,38: PRINT ""
560 '     Download transmitter program
570 PORT%=TX%
580 '     Set com2 to 4800 baud, 8, 1, and none
590 OUT &H2FB,&H80 'set DLAB high
600 OUT &H2F8,&H18 'set LSB of divisor
610 OUT &H2F9,0 'set MSB of divisor
620 OUT &H2FB,&H33 'set DLAB low, 8 data bits, no parity (?), 1 stop bit
630 A$="100 @%F6=0": GOSUB 2120
640 A$="110 @%E000=%FF: @2=%F: @2=0": GOSUB 2120
650 A$="120 INPUT R,V": GOSUB 2120
660 A$="130 IF R<0 GOTO 200": GOSUB 2120
670 A$="140 IF R>3 GOTO 200": GOSUB 2120
680 IF PR%=0 THEN LOCATE 9,38: PRINT ""
690 A$="170 IF V<0 GOTO 200": GOSUB 2120
700 A$="180 IF V>255 GOTO 200": GOSUB 2120
710 A$="190 GOTO 210": GOSUB 2120
720 A$="200 PRINT "+CHR$(34)+"E"+CHR$(34)+";: GOTO 120": GOSUB 2120
730 A$="210 IF R=0 THEN G=1": GOSUB 2120
740 IF PR%=0 THEN LOCATE 9,38: PRINT ""
750 A$="220 IF R=1 THEN G=2": GOSUB 2120
760 A$="230 IF R=2 THEN G=4": GOSUB 2120
770 A$="240 IF R=3 THEN G=8": GOSUB 2120
780 A$="260 @%E000=V: @2=G: @2=0": GOSUB 2120
790 A$="270 PRINT "+CHR$(34)+"0"+CHR$(34)+";": GOSUB 2120
800 IF PR%=0 THEN LOCATE 9,38: PRINT ""
810 A$="280 GOTO 120": GOSUB 2120
820 A$="run":GOSUB 2120
830 IF PR%=1 THEN 850
840 CLS: GOSUB 2720 ' turn on boxes
850 B$="200": GOSUB 2330: GOSUB 2470 ' initialize control regs
860 B$="210": GOSUB 2330: B$="21127": GOSUB 2470  'set atten to 127 dB
870 B$="220": GOSUB 2330: GOSUB 2470
880 B$="230": GOSUB 2330: GOSUB 2470
890 LOCATE 12,19: PRINT "Mission Research Shield Monitoring System";
900 LOCATE 14,26: PRINT "1.  Self Check/Calibration";
910 LOCATE 15,26: PRINT "2.  Data Acquisition Run";
920 LOCATE 16,26: PRINT "3.  Acquire/Save Baseline Data";
930 LOCATE 17,26: PRINT "4.  Load Old Baseline Data From Disk";
931 LOCATE 18,26: PRINT "5.  Load Old Calibration Data From Disk";
```

```
940 LOCATE 20,18: PRINT "Please enter the number of your selection";:INPUT
Z$
950 IF Z$="1" THEN 1000
960 IF Z$="2" THEN 1670
970 IF Z$="3" THEN 2820
980 IF Z$="4" THEN 3320
981 IF Z$="5" THEN 4000
990 BEEP: GOTO 890
1000 '  Self check/calibration section
1030 B$="107": GOSUB 2470 'select var atten at TX output
1040 B$="111": GOSUB 2330 ' select var atten at RX input
1050 B$="132": GOSUB 2470 'select TX freq #3 (30.015 MHz)
1060 B$="132": GOSUB 2330 'select RX LO #3 (39.015 MHZ)
1070 '    enable transmitter here
1080 FOR DBM%=LEAST% TO MOST% STEP -1 '
1090    B$="21"+STR$(DBM%): GOSUB 2470  'set var atten
1100    FOR G=0 TO 50: NEXT G  'wait for system to stabilize
1110    B$="90": GOSUB 2330  'read A/D converter for LF section
1120    CAL%(DBM%)=VAL(MID$(E$,7,4)) 'put count value into CAL array
1130 NEXT DBM%
1140 '    disable transmitter here
1150 B$="007": GOSUB 2470 'deselect var atten at TX output
1160 B$="011": GOSUB 2330 'deselect var atten at RX input
1170 B$="032": GOSUB 2470 'deselect TX freq #3 (30.015 MHz)
1180 B$="032": GOSUB 2330 'deselect RX LO #3 (39.015 MHz)
1190 B$="21127": GOSUB 2470 'set atten to 127 dB while not used
1200 '    Plot routine for calibration data
1210 CLS
1220 '    set plot border coordinates
1230 TOP%=6
1240 BOTTOM%=366
1250 LEFT%=60
1260 RIGHT%=584
1270 '    draw graticule
1280 LINE(LEFT%,TOP%)-(LEFT%,BOTTOM%)
1290 LINE (LEFT%,BOTTOM%)-(RIGHT%,BOTTOM%)
1300 LINE(RIGHT%,BOTTOM%)-(RIGHT%,TOP%)
1310 LINE (RIGHT%,TOP%)-(LEFT%,TOP%)
1320 '    write 11 tic marks
1330 FOR I%=1 TO 11
1340    P%=TOP%+(I%*(BOTTOM%-TOP%)/11)
1350    LINE(LEFT%-4,P%)-(LEFT%+4,P%)
1360 NEXT I%
1370 '    label the tick marks
1380 FOR I%=1 TO 12
1390    LOCATE (I%*2)-1,2
1400    PRINT "-";(I%*10)-10
1410 NEXT I%
1420 '    scan CAL array for max and min
1430 MIN%=9999: MAX%=-1
1440 FOR DBM%=LEAST% TO MOST% STEP -1
1450    IF CAL%(DBM%)>MAX% THEN MAX%=CAL%(DBM%)
```

```
1460    IF CAL%(DBM%)<MIN% THEN MIN%=CAL%(DBM%)
1470 NEXT DBM%
1480 LOCATE 24,7: PRINT MIN%;
1490 LOCATE 24,71: PRINT MAX%;
1500 LOCATE 24,35: PRINT "AGC LEVEL, Counts               ";
1510 '    scale array and plot points
1520 FOR DBM%=LEAST% TO MOST% STEP -1
1530    X%=LEFT%+((CAL%(DBM%)-MIN%)/(MAX%-MIN%))*(RIGHT%-LEFT%)
1540    Y%=TOP%+((DBM%-MOST%)/(LEAST%-MOST%))*(BOTTOM%-TOP%)
1550    PSET(X%,Y%)
1560 NEXT DBM%
1570 INPUT Z$
1571 OPEN "cal.dat" FOR OUTPUT AS 3
1572 FOR DBM%=LEAST% TO MOST% STEP -1
1573 WRITE #3,CAL%(DBM%)
1574 NEXT DBM%
1575 CLOSE #3
1580 IF PR%=1 THEN 890
1590 CLS: GOSUB 2720 'turn boxes back on
1600 FOR I%=0 TO 3 'put in current values
1610    J%=R%(I%): GOSUB 2600
1620    LOCATE 3,39+(10*I%): PRINT S$;
1630    J%=T%(I%): GOSUB 2600
1640    LOCATE 8,39+(10*I%): PRINT S$;
1650 NEXT I%
1660 GOTO 890
1670 '    Data acquisition run begins here
1680 FOR C%=0 TO CHANNEL%
1690      '   B$="10"+STR$(C%): GOSUB 2210 'select driver
1700      '   GOSUB 2070 'select sensor w/ same value of B$
1710 B$="20"+STR$(2^C%): GOSUB 2470 'select driver
1720 GOSUB 2330 'select sensor w/ same value of B$
1730    FOR F%=0 TO FREQ%
1740       B$="13"+STR$(F%): GOSUB 2470 'select TX freq
1750       GOSUB 2330 'select LO in RX with same value of B$
1760 B$="20"+STR$(2^C%): GOSUB 2470 'select driver
1770 GOSUB 2330 'select sensor w/ same value of B$
1780   'enable TX here
1790       FOR G=0 TO 300: NEXT G  'wait for system to stabilize
1800       B$="90": GOSUB 2330  'read A/D converter for LF section
1810       RESULT%(F%,C%)=VAL(MID$(E$,7,4)) 'store result
1820       'disable TX here
1830       B$="03"+STR$(F%): GOSUB 2470 'deselect TX freq
1840       GOSUB 2330 'deselect LO in RX w/ same value of B$
1850   'convert from counts to dBM
1860          COUNT%=RESULT%(F%,C%): K%=MOST%+1
1870          IF CAL%(K%)>=COUNT% THEN K%=K%+1: GOTO 1870
1880          IF ABS(CAL%(K%)-COUNT%)<=ABS(CAL%(K%-1)-COUNT%)
              THEN AN%=K% ELSE AN%=K%-1
1890          RESULT%(F%,C%)=AN%
1900 IF ABS(RESULT%(F%,C%)-BASELINE%(F%,C%))>6 THEN BEEP:BEEP:BEEP
1910 LOCATE 3,1: PRINT "Freq","Channel";
```

```
1920 LOCATE 4,1: PRINT F%,C%;
1921              B7$=STR$(BASELINE%(F%,C%))
1922              IF LEN(B7$)>=4 THEN 1925
1923              B7$=" "+B7$: GOTO 1922
1925              R7$=STR$(RESULT%(F%,C%))
1926              IF LEN(R7$)>=4 THEN 1930
1927              R7$=" "+R7$: GOTO 1926
1930 LOCATE 6,1: PRINT "Baseline: ";B7$;"  Current Result: ";R7$;
1940    NEXT F%
1950 B$="200": GOSUB 2470 'deselect TX driver - clear drivers
1960 GOSUB 2330 'deselect RX sensor w/ same value of B$ - clear sensors
1970 NEXT C%
1980 '  load array RP%(F%,C%) for printout
1990 FOR F%=0 TO FREQ%
2000    FOR C%=0 TO CHANNEL%: RP%(F%,C%)=RESULT%(F%,C%)-BASELINE%(F%,C%):
        NEXT C%
2010 NEXT F%
2020 LPRINT "                CURRENT VARIATION FROM BASELINE"
2030 GOSUB 3410 'perform printout
2031 'This routine provides the timing delay before the program begins the
2032 'next data acquistion cycle.
2040 FOR G=0 TO 1
2050 FOR I=0 TO 30
2060 FOR J=0 TO 153
2070 NEXT J
2080 NEXT I
2090 NEXT G
2100 GOTO 1670
2110 '    Subroutine to send commands and get result
2120 A$=A$+CHR$(13)+CHR$(10)
2130 IF PORT%=TX% THEN 2270
2140 ADR=&H3F8: IF PR%=1 THEN PRINT "Receiver     ";MID$(A$,1,LEN(A$)-2)
2150 FOR I%=1 TO LEN(A$): D$=MID$(A$,I%,1): OUT ADR,ASC(D$): NEXT I%
2160 FOR G=0 TO 100: NEXT G
2170 IF EOF(1) THEN 2220
2180 E$=INPUT$(LOC(1),PORT%) 'get receive buffer
2190 L%=LEN(A$)-2
2200 IF MID$(E$,1,L%) = MID$(A$,1,L%) THEN 2250
2210 L$="Non-Match": GOTO 2230
2220 L$="EOF Condition"
2230 FOR I%=0 TO 2: SOUND I+130.8,1: SOUND I+196,1: SOUND I+329.6,1:
     SOUND I+523.3,1: SOUND I+1046.5,1: NEXT I%
2240 CLS: LOCATE 12,15: PRINT "Communication Problem with Receiver: ";L$:
END
2250 IF PR%=1 THEN PRINT "Result       ";MID$(E$,1,(LEN(A$)-2)): GOTO 2310
2260 GOTO 2310
2270 ADR=&H2F8: IF PR%=1 THEN PRINT "Transmitter  ";MID$(A$,1,LEN(A$)-2)
2280 FOR G=0 TO 100: NEXT G
2290 FOR I%=1 TO LEN(A$): D$=MID$(A$,I%,1): OUT ADR,ASC(D$): NEXT I%
2300 'For i%=1 TO LEN(E$): PRINT HEX$(ASC(MID$(E$,I%,1)));" ";: NEXT I%
2310 RETURN
2320 '    Subroutine to process receiver commands
```

```
2330 IF MID$(B$,1,1)="9" THEN 2400
2340 P1%=VAL(MID$(B$,1,1)): P2%=VAL(MID$(B$,2,1)):
P3%=VAL(MID$(B$,3,LEN(B$)-2))
2350 IF P1%=2 THEN R%(P2%)=P3%: GOTO 2390 'set value
2360 MASK%=2^P3%
2370 IF P1%=0 THEN R%(P2%)=R%(P2%) AND (NOT MASK%): GOTO 2390 'reset bit
2380 R%(P2%)=R%(P2%) OR (MASK%) 'set bit
2390 A$=MID$(B$,2,1) + "," + STR$(R%(P2%)): GOTO 2410
2400 A$=MID$(B$,1,1) + "," + MID$(B$,2,1)
2410 IF PR%=1 THEN 2440
2420 J%=R%(P2%): GOSUB 2600 ' do conversion
2430 LOCATE 3,39+(10*P2%): PRINT S$;
2440 PORT%=RX%: GOSUB 2120
2450 RETURN
2460 '    Subroutine to process transmitter commands
2470 P1%=VAL(MID$(B$,1,1)): P2%=VAL(MID$(B$,2,1)):
P3%=VAL(MID$(B$,3,LEN(B$)-2))
2480 IF P1%=2 THEN T%(P2%)=P3%: GOTO 2520 'set value
2490 MASK%=2^P3%
2500 IF P1%=0 THEN T%(P2%)=T%(P2%) AND (NOT MASK%): GOTO 2520 'reset bit
2510 T%(P2%)=T%(P2%) OR (MASK%) 'set bit
2520 A$=MID$(B$,2,1) + "," + STR$(T%(P2%))
2530 IF PR%=1 THEN 2580
2540 J%=T%(P2%): GOSUB 2600 ' do conversion
2550 LOCATE 8,39+(10*P2%): PRINT S$;
2560 IF P2%<>1 THEN 2580
2570 LOCATE 10,52: PRINT T%(P2%);
2580 PORT%=TX%: GOSUB 2120
2590 RETURN
2600 '    Subroutine to do binary conversion - input J%, output S$
2610 S$=""
2620 FOR BIT%=0 TO 3
2630    MASK%=2^BIT%
2640    IF J% AND MASK% THEN S$=" "+S$ ELSE S$=""+S$
2650 NEXT BIT%
2660 S$=" "+S$
2670 FOR BIT% = 4 TO 7
2680    MASK%=2^BIT%
2690    IF J% AND MASK% THEN S$=" "+S$ ELSE S$=""+S$
2700 NEXT BIT%
2710 RETURN
2720 '    Subroutine to draw the boxes
2730 LOCATE 1,38: PRINT "   R(0)      R(1)      R(2)      R(3)"
2740 LOCATE 2,38: PRINT ""
2750 LOCATE 3,38: PRINT "                                       "
2760 LOCATE 4,38: PRINT ""
2770 LOCATE 6,38: PRINT "   T(0)      T(1)      T(2)      T(3)"
2780 LOCATE 7,38: PRINT ""
2790 LOCATE 8,38: PRINT "                                       "
2800 LOCATE 9,38: PRINT ""
2810 RETURN
2820 '    Acquire/Save Baseline data
```

```
2830 FOR C%=0 TO CHANNEL%
2840     '   B$="10"+STR$(C%): GOSUB 2210 'select driver
2850     '   GOSUB 2070 'select sensor w/ same value of B$
2860 B$="20"+STR$(2^C%): GOSUB 2470 'select driver
2870 GOSUB 2330 'select sensor w/ same value of B$
2880       FOR F%=0 TO FREQ%
2890          B$="13"+STR$(F%): GOSUB 2470 'select TX freq
2900          GOSUB 2330 'select LO in RX w/ same value of B$
2910 B$="20"+STR$(2^C%): GOSUB 2470 'select driver
2920 GOSUB 2330 'select sensor w/ same value of B$
2930          'enable TX here
2940          FOR G=0 TO 300: NEXT G  'wait for system to stabilize
2950          B$="90": GOSUB 2330  'read A/D converter for LF section
2960          BASELINE%(F%,C%)=VAL(MID$(E$,7,4)) 'store result
2970 LOCATE 3,1: PRINT "Freq","Channel";
2980 LOCATE 4,1: PRINT F%,C%;
2981                          B7$=STR$(BASELINE%(F%,C%))
2982                          IF LEN(B7$)>=4 THEN 2990
2983                          B7$=" "+B7$: GOTO 2982
2990 LOCATE 6,1: PRINT "A/D Counts: ";B7$;
3000          'disable TX here
3010          B$="03"+STR$(F%): GOSUB 2470 'deselect TX freq
3020          GOSUB 2330 'deselect LO in RX w/ same value of B$
3030       NEXT F%
3040 B$="200": GOSUB 2470 'deselect TX driver - clear drivers
3050 GOSUB 2330 'deselect RX sensor w/ same value of B$ - clear sensors
3060 NEXT C%
3070 '  convert baseline array from counts to dBM
3090 FOR C%=0 TO CHANNEL%
3100    FOR F%=0 TO FREQ%
3110       COUNT%=BASELINE%(F%,C%): K%=MOST%+1
3120       IF CAL%(K%)>=COUNT% THEN K%=K%+1: GOTO 3120
3130       IF ABS(CAL%(K%)-COUNT%)<=ABS(CAL%(K%-1)-COUNT%) THEN AN%=K%
           ELSE AN%=K%-1
3140       BASELINE%(F%,C%)=AN%
3150    NEXT F%
3160 NEXT C%
3170 '  save baseline data array
3180 OPEN "BASELINE.DAT" FOR OUTPUT AS 3
3190 FOR F%=0 TO FREQ%
3200    FOR C%=0 TO CHANNEL%
3210       WRITE #3, BASELINE%(F%,C%)
3220    NEXT C%
3230 NEXT F%
3240 CLOSE #3
3250 '  load array RP%(F%,C%) for printout
3260 FOR F%=0 TO FREQ%
3270    FOR C%=0 TO CHANNEL%: RP%(F%,C%)=BASELINE%(F%,C%): NEXT C%
3280 NEXT F%
3290 LPRINT "                    BASELINE DATA"
3300 GOSUB 3410 'perform printout
3310 GOTO 890
```

```
3320 '  get baseline data array from disk
3330 OPEN "BASELINE.DAT" FOR INPUT AS 4
3340 FOR F%=0 TO FREQ%
3350    FOR C%=0 TO CHANNEL%
3360        INPUT #4, BASELINE%(F%,C%)
3370    NEXT C%
3380 NEXT F%
3390 CLOSE #4
3400 GOTO 890
3410 '  report printer sub -- input array RP%(F%,C%)
3420 LPRINT
3430 LPRINT "     MRC/UD SHIELD ROOM MONITOR SYSTEM        ";TIME$;
"  ";DATE$
3440 LPRINT:LPRINT
3450 LPRINT "    CHANNEL      0      1                    "
3451 ' or  LPRINT "    CHANNEL      0      1      2      3      4" for
3452 ' more ch.
3460 LPRINT " FREQ"
3470 FOR F%=0 TO FREQ%
3480 LPRINT
3490 LPRINT USING "   #          ###     ###" ;F%,RP%(F%,0),RP%(F%,1)
3491 ' The following option will provide for five channels
3492 ' remember to replace line 3490 with the two following lines
3493 ' and that the two lines must be on one line not as shown.
3494 'LPRINT USING "   #          ###     ###     ###     ###     ###
3495 '";F%,RP%(F%,0),RP%(F%,1)',RP%(F%,2),RP%(F%,3),RP%(F%,4)
3500 NEXT F%
3510 LPRINT:LPRINT
3520 RETURN
4000 'routine to get old cal off disk
4010 OPEN "cal.dat" FOR INPUT AS 4
4020 FOR DBM%=LEAST% TO MOST% STEP -1
4030 INPUT #4, CAL%(DBM%)
4040 NEXT DBM%
4050 CLOSE #4
4060 GOTO 890
```